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F/G 17/1

TEST RESULTS OF SQS-23/PAIR (AN/SQG-23) TRANSMITTER AND THE RAY--ETC(U)

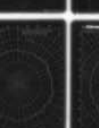
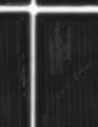
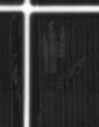
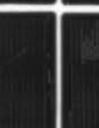
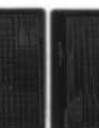
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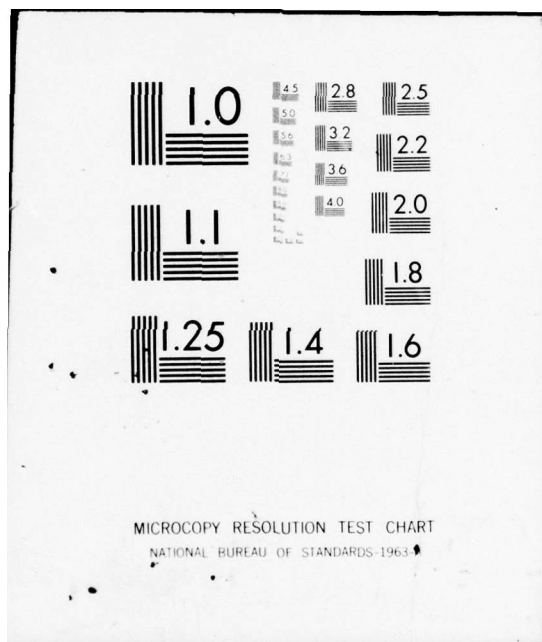
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If cited in the literature the information is to be identified as tentative and unpublished.

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NEL/Technical Memorandum 1060

TECHNICAL MEMORANDUM TM-1060

TEST RESULTS OF SQS-23/PAIR (AN/SQQ-23) TRANSMITTER AND THE RATHEON TR-197
TRANSDUCER (U)

16 August 1966

H. J. Klee (NEL Code 2140)

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NEL/Technical Memorandum 1060

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NEL Technical Memorandum
Number 1060

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Test Results of SQS-23/PAIR (AN/SQQ-23)
Transmitter and the
Raytheon TR-197 Transducer.

by

10
H. J. Klee

Code 2140

U. S. Navy Electronics Laboratory
San Diego, California 92152

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16 August 1966

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This technical memorandum represents a portion of the work being done on NEL Problem J714, AN/SQS-23 Performance and Integration Retrofit (PAIR) Program. It should not be construed as a formal report as its primary intent is to present some of the problems confronting project personnel and some of the preliminary conclusions. While it was originally published in a different form, it is now being included in the technical memorandum series for sake of documentation uniformity and control. Limited outside distribution is intended.

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TABLE OF DRAWINGS

1. Table 1 - PAIR Transmitter worst case DC power requirements with TR-197 transducer
2. Table 2 - Tabulated data for SQS-23G/PAIR transmitter with TR-197 transducer
3. Graph 1 - Source level (all operating modes) vs frequency
4. Graph 2 - Transducer element impedance and phase variation vs beam number, stave #1, 4.5 kc
5. Graph 3 - Transducer element impedance and phase variation vs beam number, stave #4, 4.5 kc
6. Graph 4 - Transducer element impedance and phase variation vs beam number, stave #1, 5.5 kc
7. Graph 5 - Transducer element impedance and phase variation vs beam number, stave #4, 5.5 kc
8. Graph 6 - Transducer element impedance and phase variation vs frequency, stave #1
9. Graph 7 - Transducer element impedance and phase variation vs frequency, stave #4
10. Graph 8 - Transmitter plate circuit dissipation vs frequency, Stave #1
11. Graph 9 - Transmitter plate circuit dissipation vs frequency, Stave #4
12. Graph 10 - Transmitter plate circuit efficiency vs frequency, Stave #1
13. Graph 11 - Transmitter plate circuit efficiency vs frequency, Stave #4
14. Graph 12 - Harmonic distortion vs frequency (electrical, $f_o = 4.5$ kc)
15. Graph 13 - Harmonic distortion vs frequency (acoustic, $f_o = 4.5$ kc, SMT)
16. Graph 14 - Harmonic distortion vs frequency (acoustic, $f_o = 4.5$ kc, RDT)
17. Graph 15 - Harmonic distortion vs frequency (acoustic, $f_o = 4.5$ kc, OMNI)
18. Graph 16 - Harmonic distortion vs frequency (electrical, $f_o = 5.5$ kc)
19. Graph 17 - Harmonic distortion vs frequency (acoustic, $f_o = 5.5$ kc, SMT)
20. Graph 18 - Harmonic distortion vs frequency (acoustic, $f_o = 5.5$ kc, RDT)
21. Graph 19 - Harmonic distortion vs frequency (acoustic, $f_o = 5.5$ kc, OMNI)
22. Graph 20 - Transducer element impedance and phase variation vs operating depth, stave #1, 4.5 kc
23. Graph 21 - Transducer element impedance and phase variation vs operating depth, stave #4, 4.5 kc
24. Graph 22 - Transducer element impedance and phase variation vs operating depth, stave #1, 5.5 kc
25. Graph 23 - Transducer element impedance and phase variation vs operating depth, stave #4, 5.5 kc
26. Graph 24 - Transmitter plate circuit dissipation vs operating depth, stave #1, 4.5 kc
27. Graph 25 - Transmitter plate circuit dissipation vs operating depth, stave #4, 4.5 kc
28. Graph 26 - Transmitter plate circuit dissipation vs operating depth, stave #1, 5.5 kc
29. Graph 27 - Transmitter plate circuit dissipation vs operating depth, stave #4, 5.5 kc

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TABLE OF DRAWINGS (Cont'd)

- 30. Graph 28 - Transmitter plate circuit efficiency vs operating depth, stave #1, 4.5 kc
- 31. Graph 29 - Transmitter plate circuit efficiency vs operating depth, stave #4, 4.5 kc
- 32. Graph 30 - Transmitter plate circuit efficiency vs operating depth, stave #1, 5.5 kc
- 33. Graph 31 - Transmitter plate circuit efficiency vs operating depth, stave #4, 5.5 kc
- 34. Pattern 1 - 4.5 kc, $7\frac{1}{2}^{\circ}$, SLT
- 35. Pattern 2 - 4.5 kc, 15° , SLT
- 36. Pattern 3 - 4.5 kc, 30° , SLT
- 37. Pattern 4 - 5.5 kc, $7\frac{1}{2}^{\circ}$, SLT
- 38. Pattern 5 - 5.5 kc, 15° , SLT
- 39. Pattern 6 - 5.5 kc, 30° , SLT
- 40. Pattern 7 - 4.5 kc, OMNI
- 41. Pattern 8 - 5.5 kc, OMNI
- 42. Pattern 9 - 4.5 kc, $7\frac{1}{2}^{\circ}$, SLT (vertical)
- 43. Pattern 10 - 5.5 kc, $7\frac{1}{2}^{\circ}$, SLT (vertical)

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Active testing of the SQS-23G/PAIR transmitter with Raytheon TR-197 transducer has been completed. This memorandum presents a preliminary summary of the results of the tests.

In all graphs and tables present herein, A + B refers to the transmitter drive and output connections. A + B means that transmitter A drives elements 1, 2, 3, 8 and 9 of a stave while transmitter B drives elements 4, 5, 6 and 7. In the A only, B only or the A or B mode, one transmitter drives the entire stave.

Graph 1 shows source level for all operating modes as a function of frequency. Fundamental source levels are very close to specified levels, but harmonic distortion caused harmonic source levels that are high enough (graphs 12 through 19) to be detrimental to VIS and sonic guided torpedoes. A major portion of these harmonics are generated within the "Class C" output stage of the SQS-23G transmitter. Significant reduction of the harmonic output could only be accomplished by redesign of the final stages of this power amplifier.

Graphs 2 through 7 show the variation in transducer element impedance for the TR-197 under normal PAIR operating conditions. The magnitude of the impedance varies from 20Ω to 130Ω with phase angles from -90° to $+30^\circ$. These highly variable reactive loads limit the maximum source level by high screen and plate dissipations in the transmitter output stage under the above operating conditions.

Graphs 8 through 11 present transmitter plate circuit dissipation and efficiency. Plate, screen grid, and drive voltage were adjusted to obtain the maximum possible source level consistent with the maximum power dissipation ratings for the output tubes. The output transformer was included

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as part of the plate circuit for these measurements. The dissipation in this transformer must be subtracted from the plate circuit dissipation to obtain true element dissipation. At some frequencies the plate circuit dissipation exceeds the limit set at 520 watts. This is permissible since for most PAIR operating modes the average dissipation will be less than 520 watts.

Graphs 20 through 31 present the previously mentioned data as a function of operating transducer depth. At the one-half foot depth considerable cavitation was visible in the acoustic waveform and the maximum power dissipation in the output tubes was greatly exceeded. Because of the varying depth of the transducer during normal operation, a careful look at the long term reliability of the transmitter under these operating conditions is needed.

Patterns 1 through 6 are typical patterns of the SQS-23G/PAIR transmitter with a TR-197 transducer. The relatively high side lobe levels support the previous conclusion that the beamforming delays in the TCU are not proper to form the PAIR specified transmit beam, and that transmit beams will also be a function of the active transducer type installed.

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Equipment	SQS-23G Maximum Ratings (1 unit)	PAIR Operating Requirements (with TR-197 transducer)			
		A+B 300° RDT	A+B OMNI	A or B 300° RDT	A or B OMNI.
1. High voltage M.G.s (PU-485)	2700/2450 v. 16.0 A. 0.9 sec. ON 11.1 sec. OFF	2 units 2530/2500 v. 4.7 A. 5.7 sec. ON 16.0 sec. OFF	2 units 2530/2500 v. 17.2 A. 0.32 sec. ON 4.0 sec. OFF	2 units 2530/2500 v. 4.7 A. 5.7 sec. ON 16.0 sec. OFF	2 units 2530/2500 v. 15.8 A. 0.32 sec. ON 4.0 sec. OFF
2. Screen grid M.G.s (PU-519)	875 v. 2.80 A. 0.9 sec. ON 11.1 sec. OFF	1 unit 530/500 v. 1.25 A. 5.7 sec. ON 16.0 sec. OFF	1 unit 530/500 v. 3.43 A. 0.32 sec. ON 4.0 sec. OFF	1 unit 530/500 v. 1.42 A. 5.7 sec. ON 16.0 sec. OFF	1 unit 530/500 v. 3.12 A. 0.32 sec. ON 4.0 sec. OFF
3. 325 volt M.G.s (PU-479)	325 v. 3.0 A-0.9 sec. 1.0 A-11.1 sec.	1 unit 325 v. 3.25A-5.7 sec. 2.66A-16 sec.	1 unit 325 v. 4.68A-.32 sec. 2.66A-4.0 sec.	1 unit 325 v. 1.73A-5.7 sec. 1.33A-16 sec.	1 unit 325 v. 2.35A-.32 sec. 1.33A-4.0 sec.
4. 300/500 v. Bias supply	300 v. 0.25 A. 12 %	300 v. 0.21A. 25 %	300 v. 0.57A. 7.4 %	300 v. 0.11A. 25 %	300 v. 0.28A. 7.4 %
E I Duty cycle					

Table I

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Tabulated Data	
SQS-23G/PAIR-Transmitter	
TR-197 Transducer	
Mode A+B	
8/8/66	
$E_{bb} = 2500$ volts	
$E_{c2} = 500$ volts	
Drive to Trans = 0.14 vrms	

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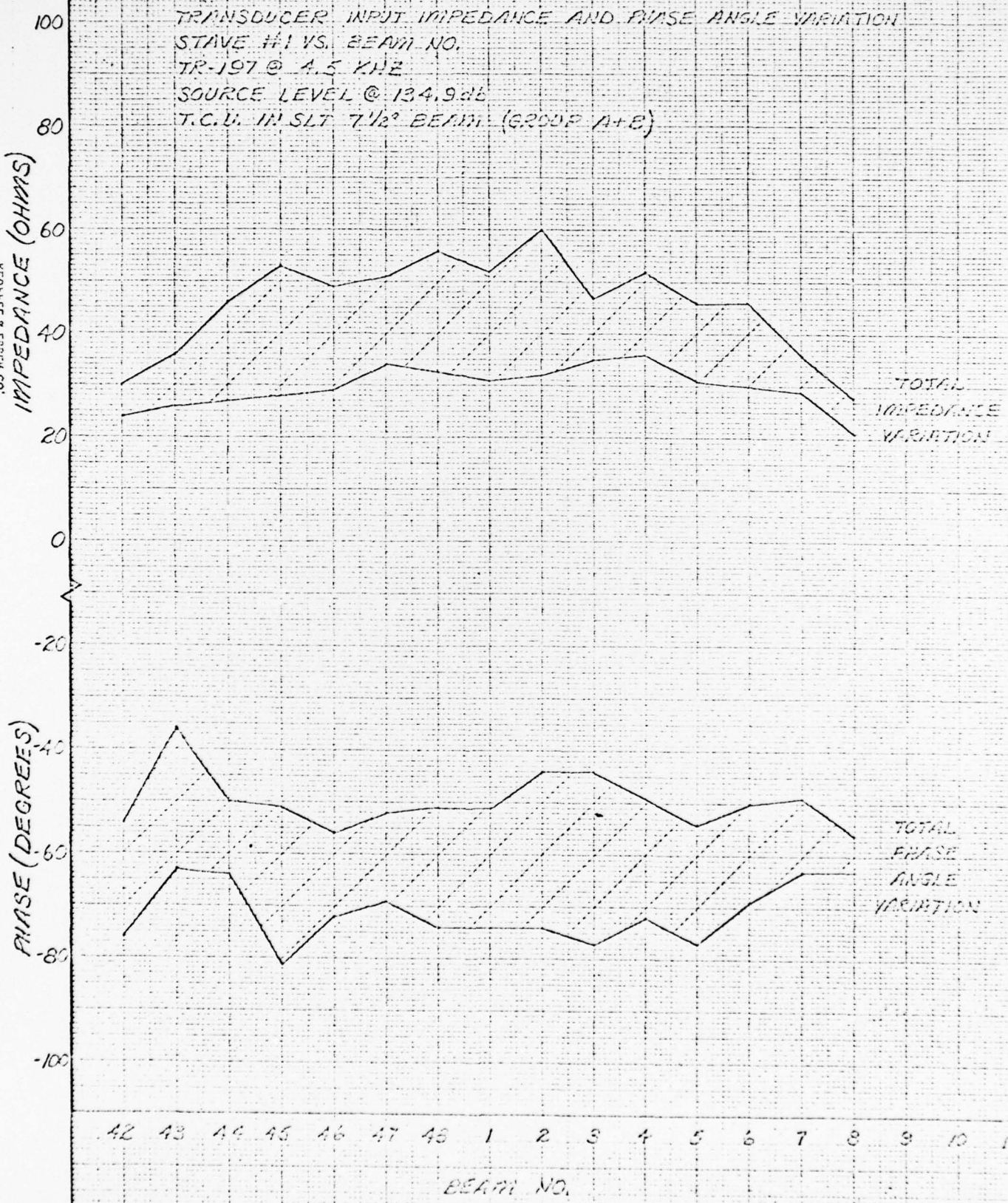
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SOURCE LEVEL db REF. MEAN AT ONE YARD	MODE A+B MODE A ONLY MODE ORINI A+B MODE ORINI A ONLY MODE A ONLY WICC MODE ORINI A ONLY WICC	SOURCE LEVEL TR-197 (RAYTHEON) ALL OPERATING MODES VS. FREQUENCY	FREQUENCY (KHz)
140			4.3
138			4.5
136			4.7
134			5.0
132			5.3
130			5.5
128			5.7

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VICTOR



Graph 2

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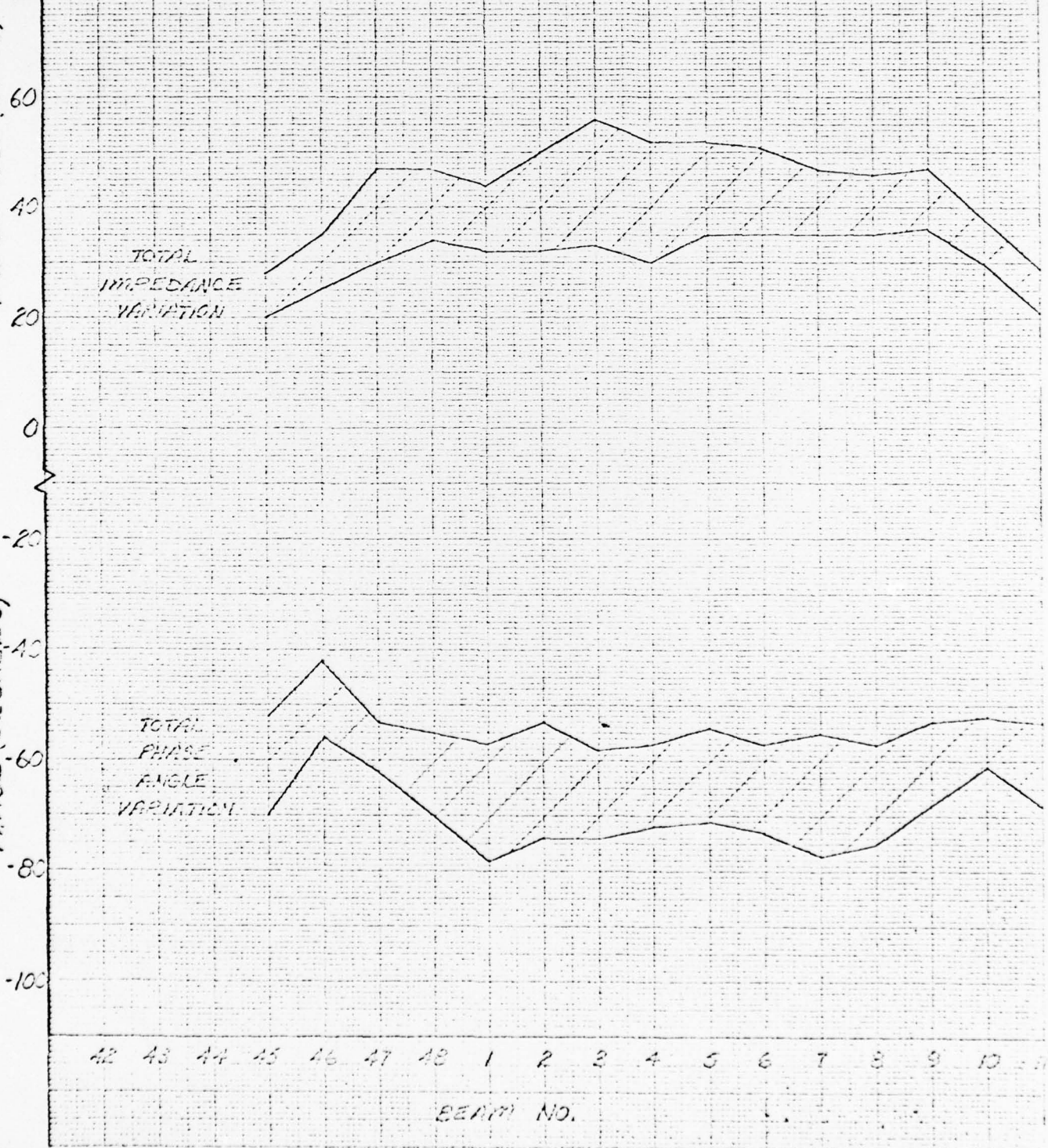
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IMPEDANCE (OHMS)

PHASE (DEGREES)

TRANSDUCER INPUT IMPEDANCE AND PHASE ANGLE VARIATION
STATE # 4 VS. BEAM NO.
TR-197 @ 4.5 KHZ
SOURCE LEVEL @ 134.9 db
T.C.U. IN SLT 7 1/2° BEAM (GROUP A+B)



Graph 3

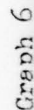
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40 X 10 TO 100 CM
40 X 10 TO 100 CM
40 X 10 TO 100 CM



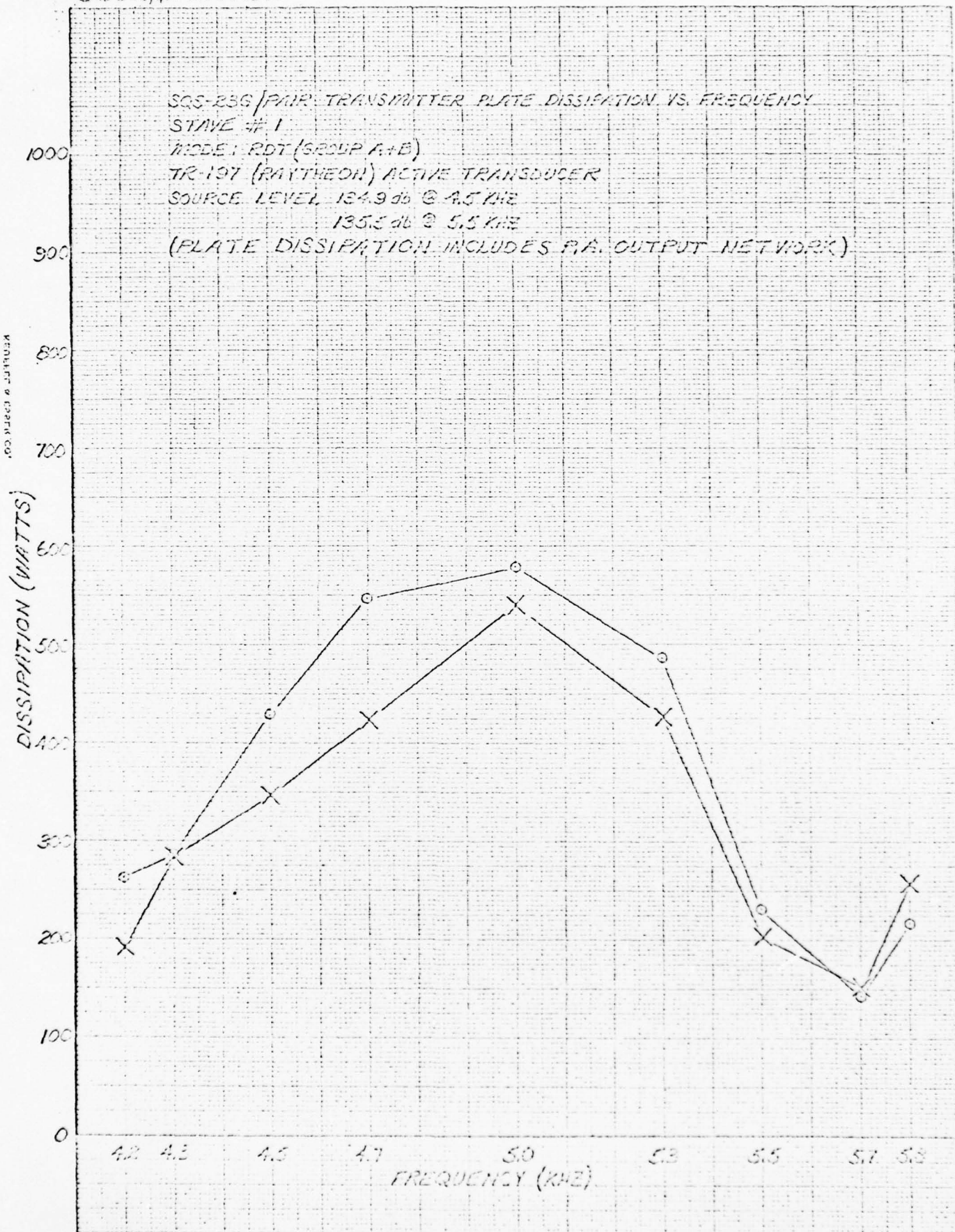
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Graph 8

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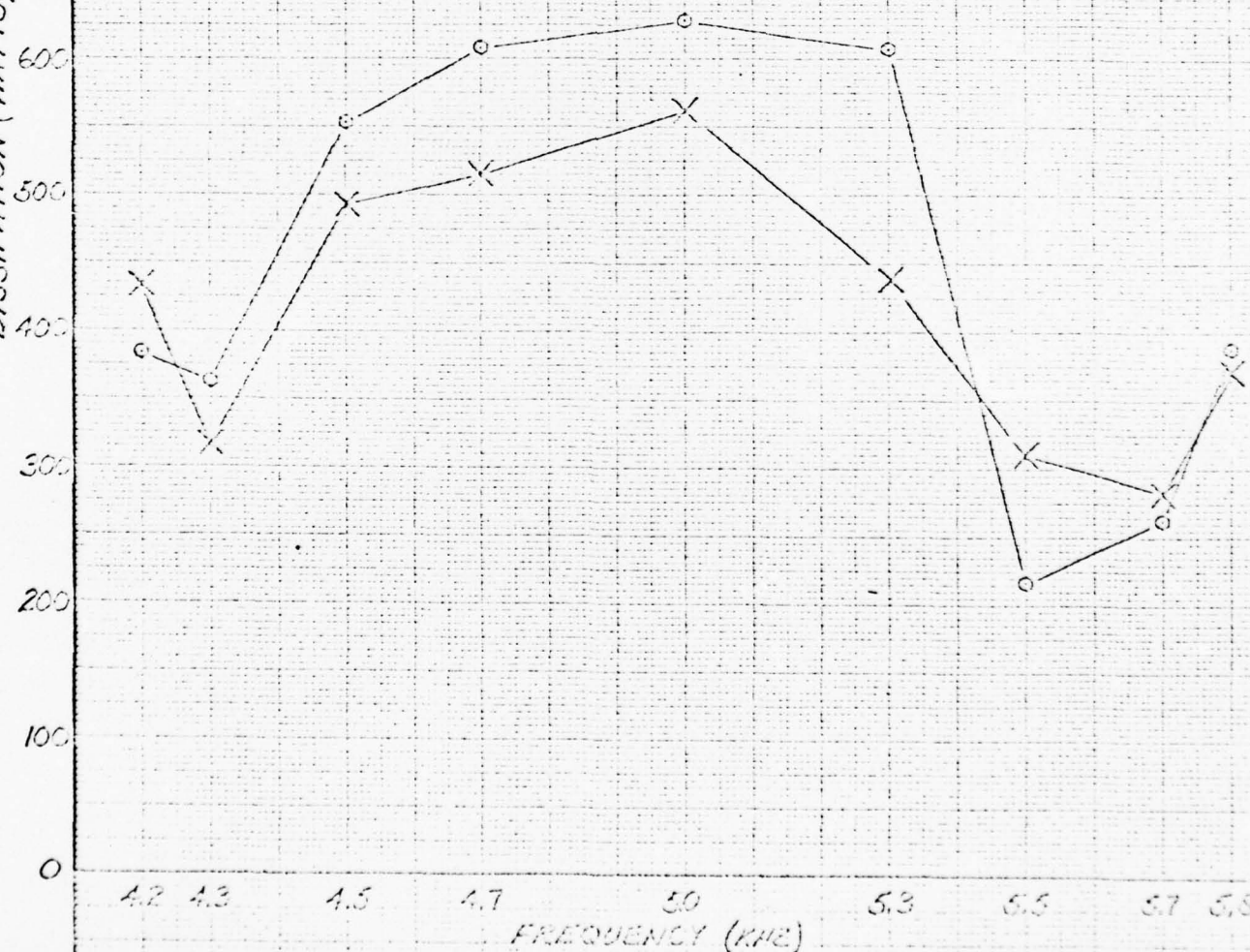
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SQS-235/PAR TRANSMITTER PLATE DISSIPATION VS. FREQUENCY
 STAGE #4
 MODE: RDT (GROUP A+E)
 TR-197 (PANTHEON) ACTIVE TRANSDUCER
 SOURCE LEVEL 134.9 db @ 4.5 KHZ
 125.5 db @ 5.5 KHZ
 (PLATE DISSIPATION INCLUDES PA OUTPUT NETWORK)

DISSIPATION (WATTS)

1000
900
800
700
600
500
400
300
200
100
0

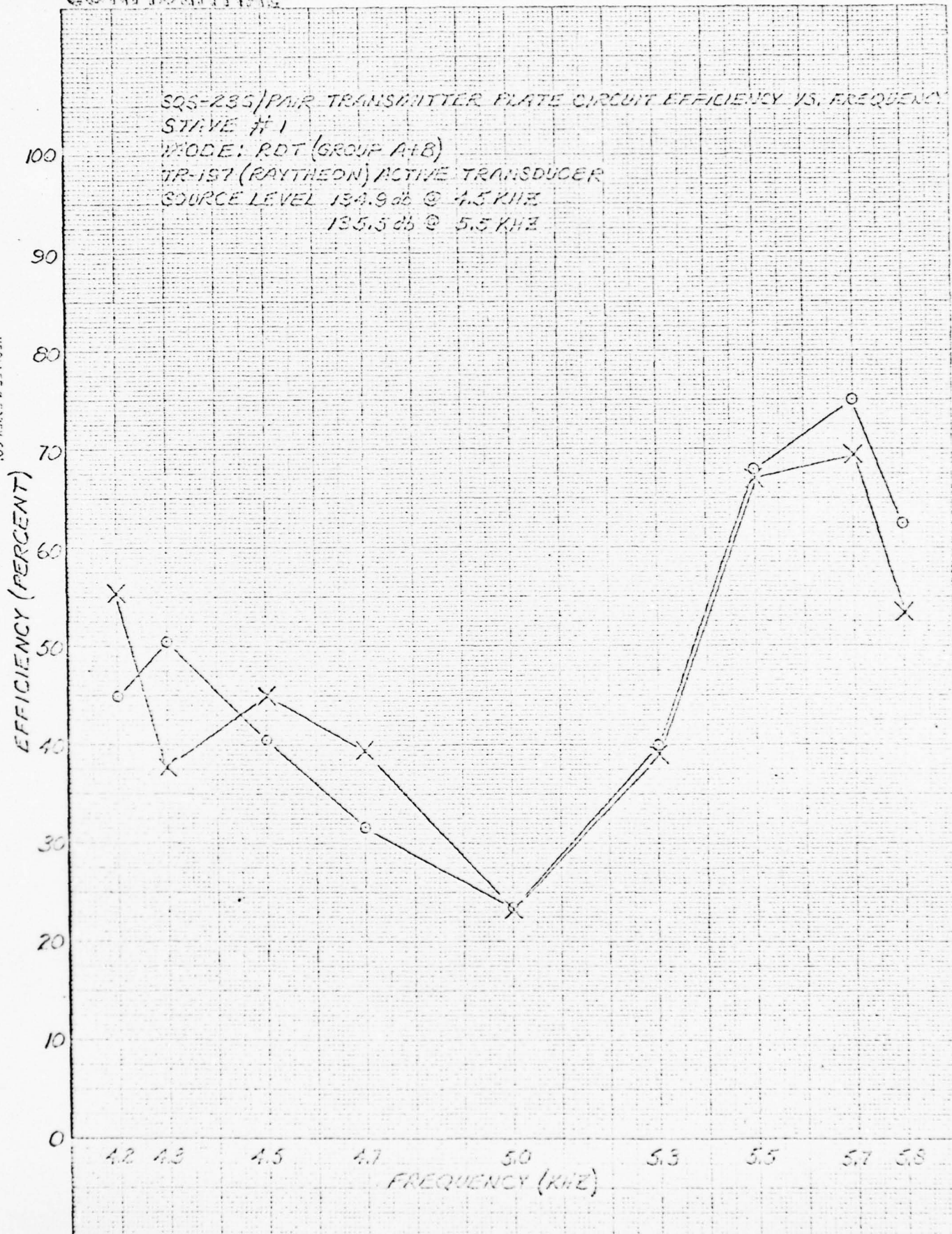
4.2 4.3 4.5 4.7 5.0 5.3 5.5 5.7 5.8
 FREQUENCY (KHZ)



Graph 9

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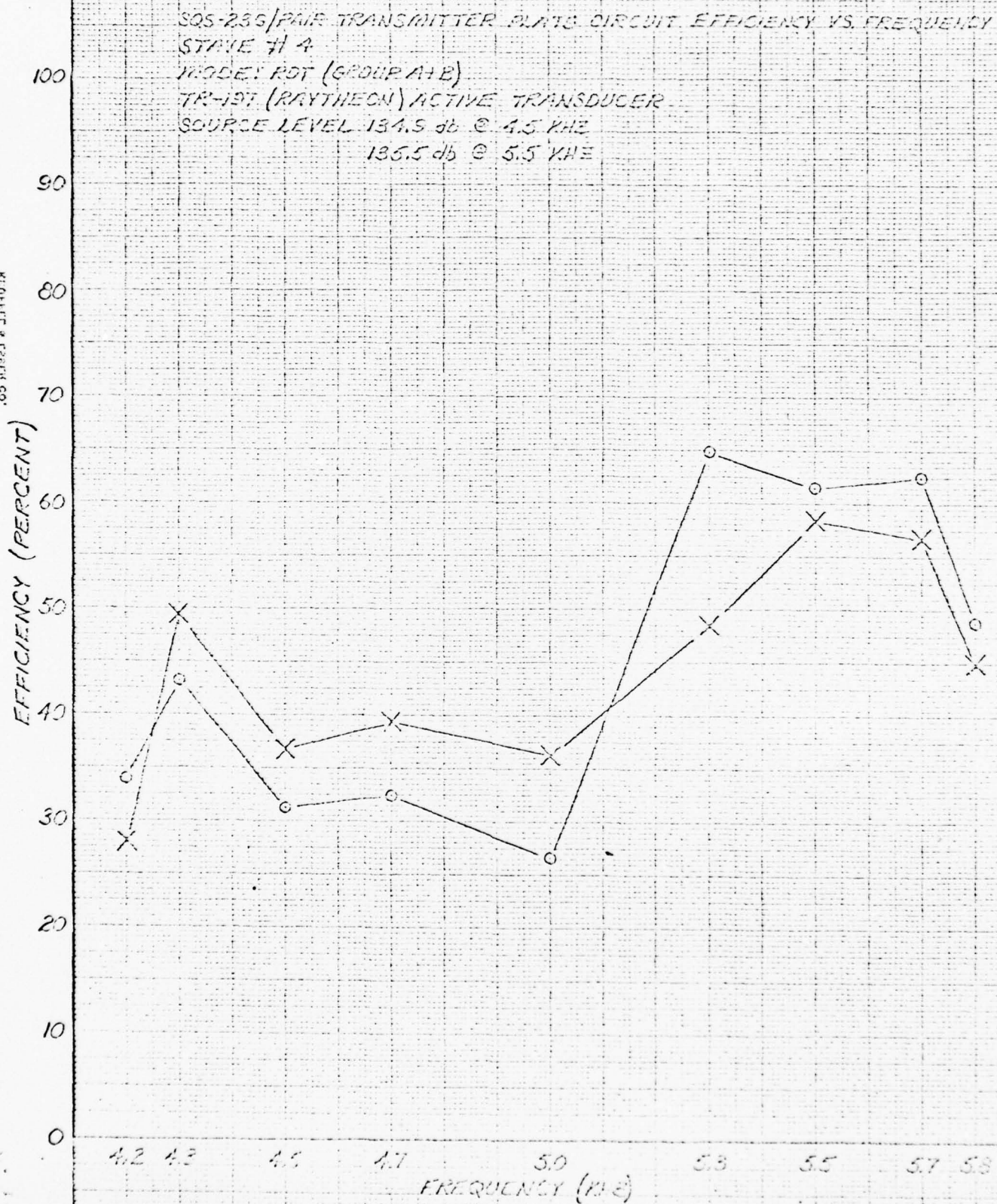
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Graph 10

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Graph 11

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140

120

100

SOURCE LEVEL (db/microbar/yard)

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HARMONIC DISTORTION ANALYSIS
OF ACOUSTIC SIGNAL

TRANSDUCER: TR-197

1.3 SECONDS OF C.M.

FILTER BAND WIDTH: 200 HZ

MODE: *onini*

TRANSMISSION FREQUENCY: 5.5 KHZ

O A+B

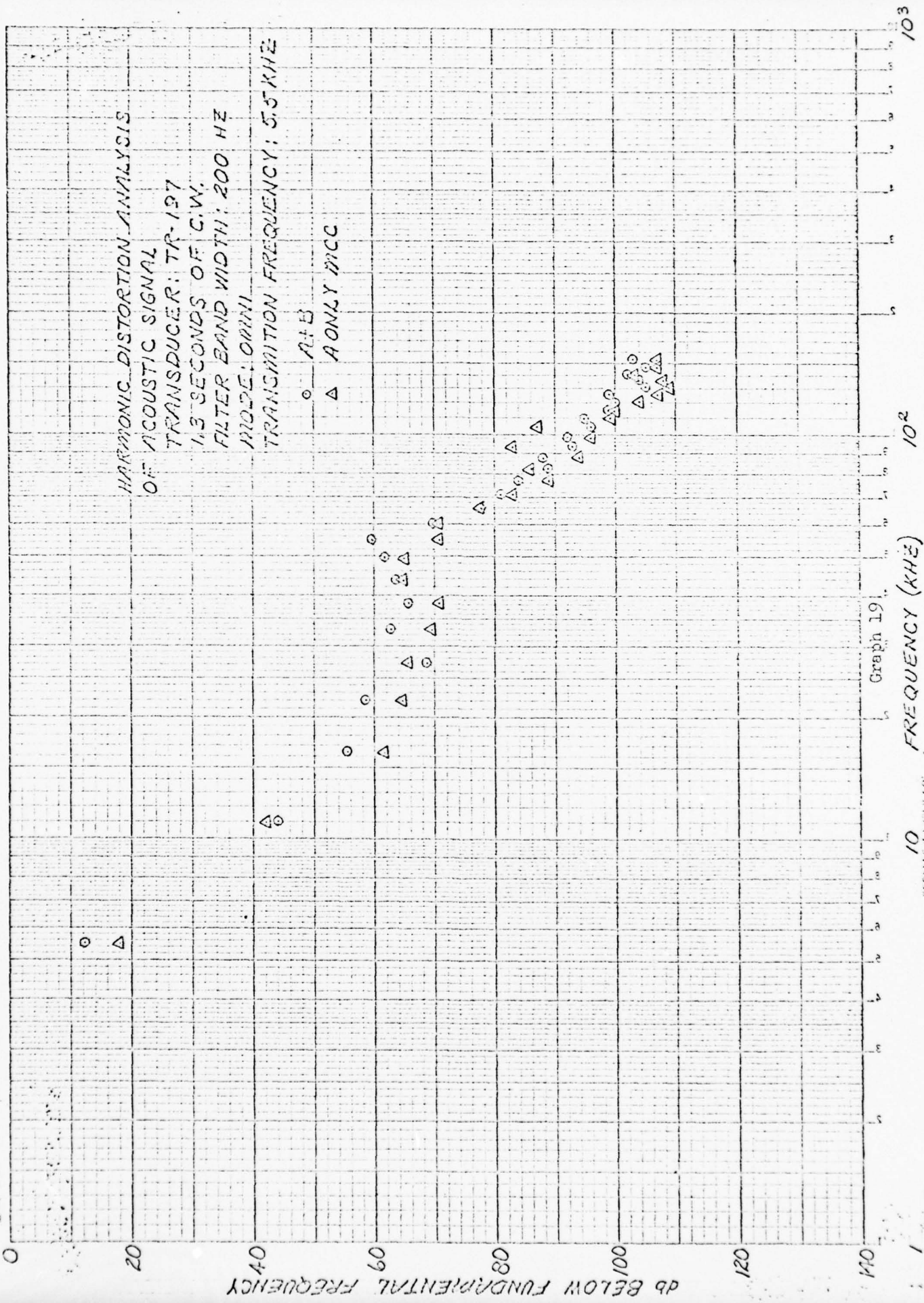
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FREQUENCY (KHZ)

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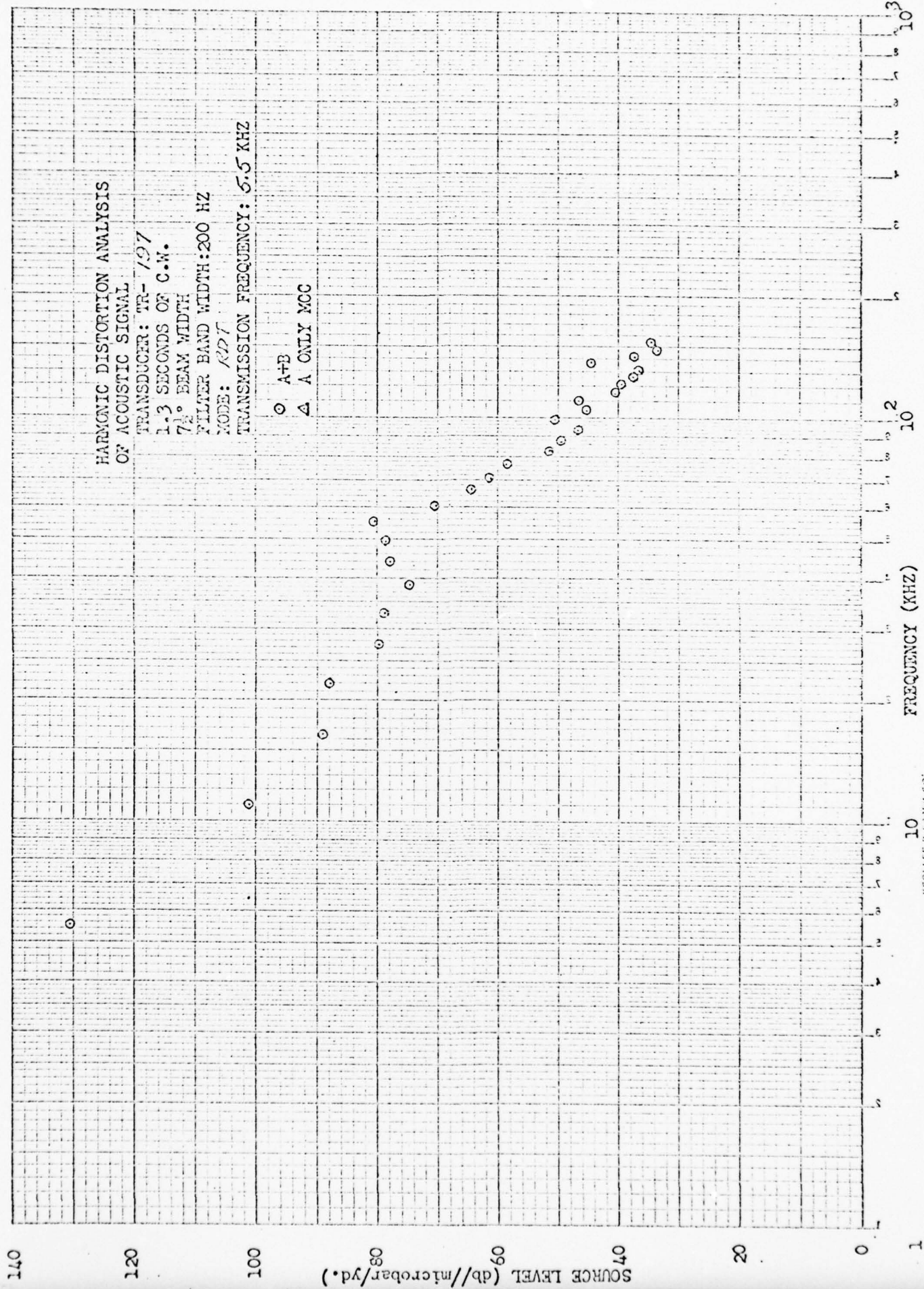
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TRANSDUCER: TR-197

1.3 SECONDS OF C.W.

7.5° BEAR 127 WIDTH

FILTER BAND WIDTH: 200 HZ

MODE: RDT

TRANSMISSION FREQUENCY: 5.5 KHZ

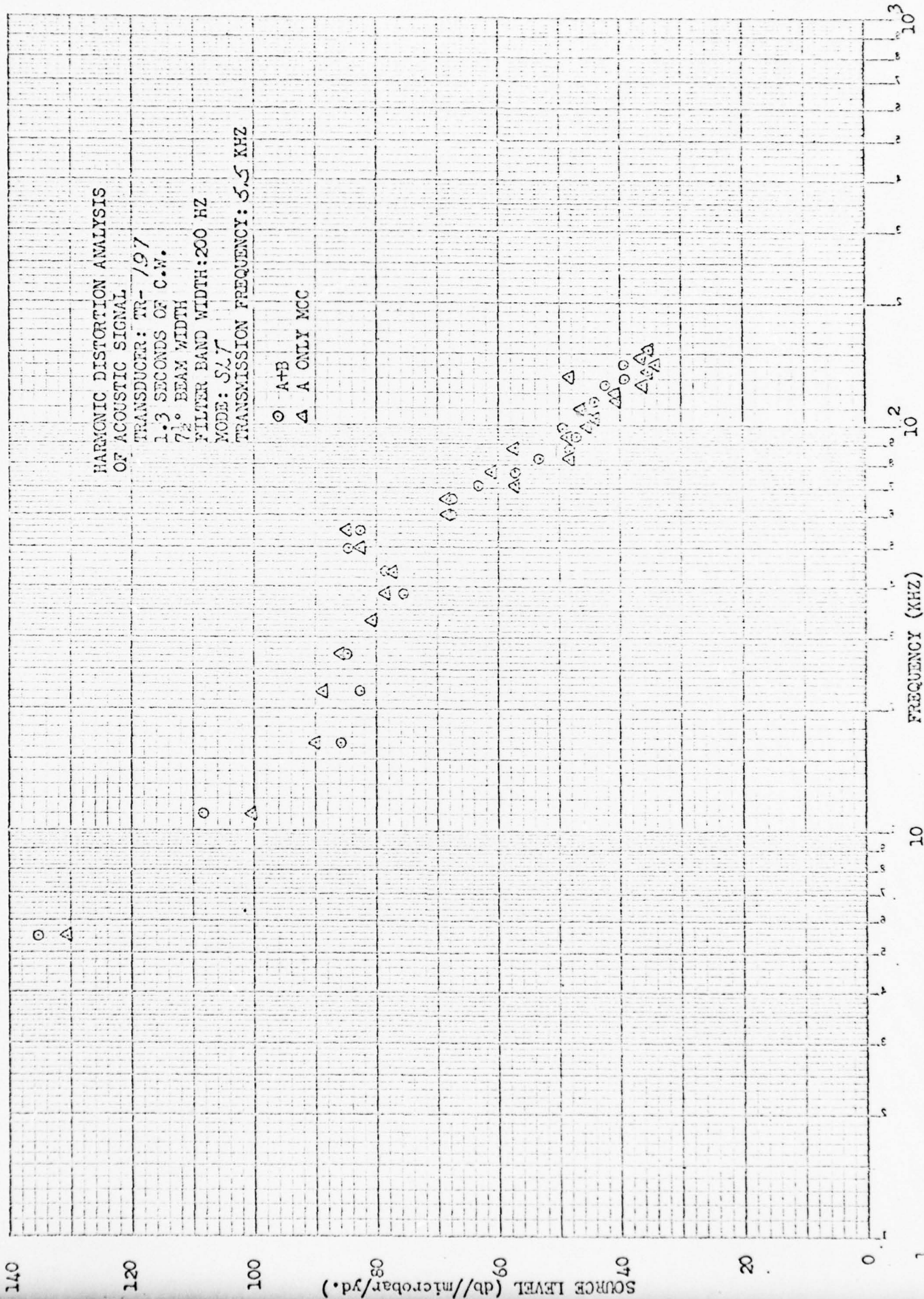


Graph 18
FREQUENCY (KHz)

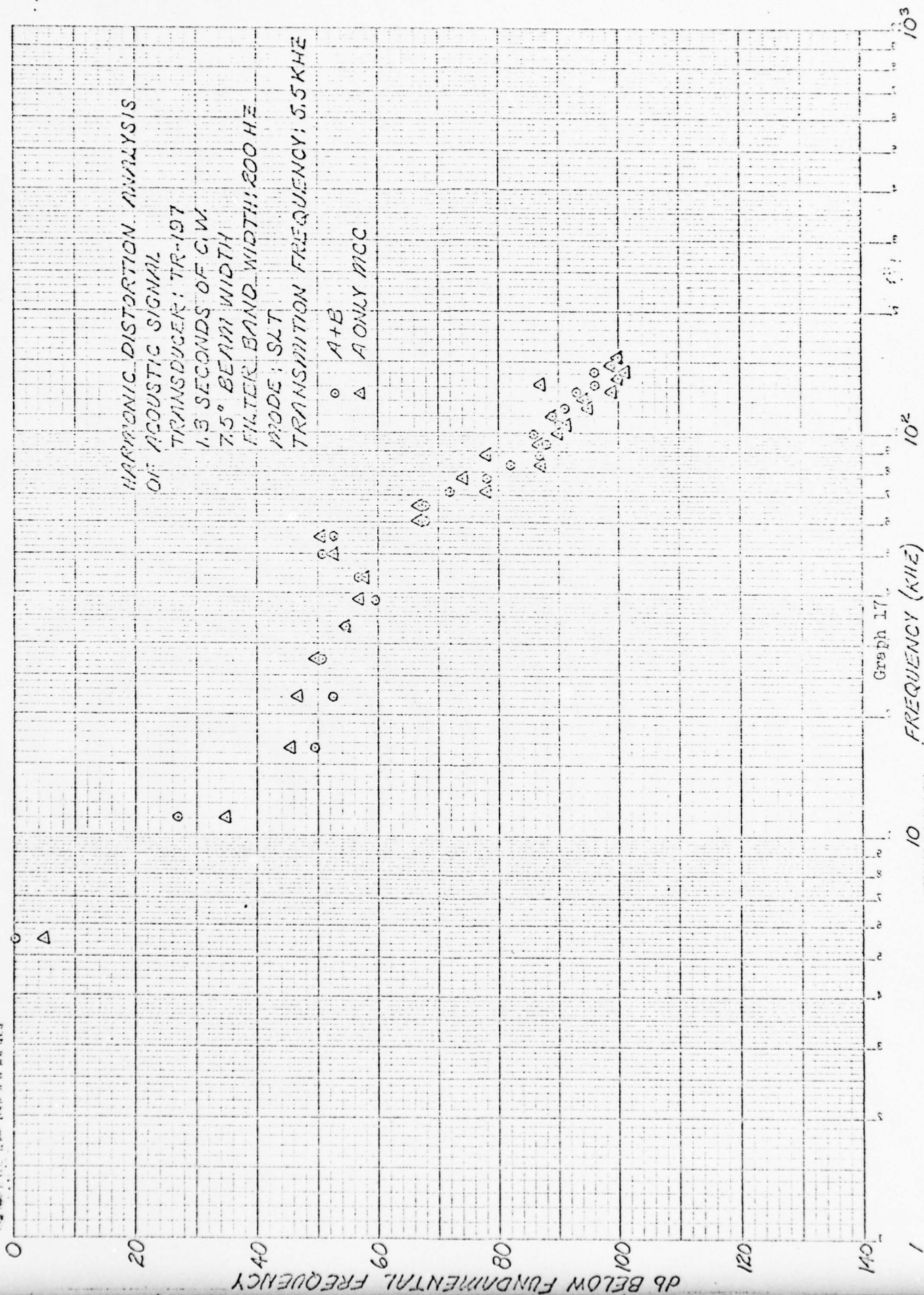
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HARMONIC DISTORTION ANALYSIS OF ACOUSTIC SIGNAL

TRANSDUCER: TR-197

1.3 SECONDS OF C.W.

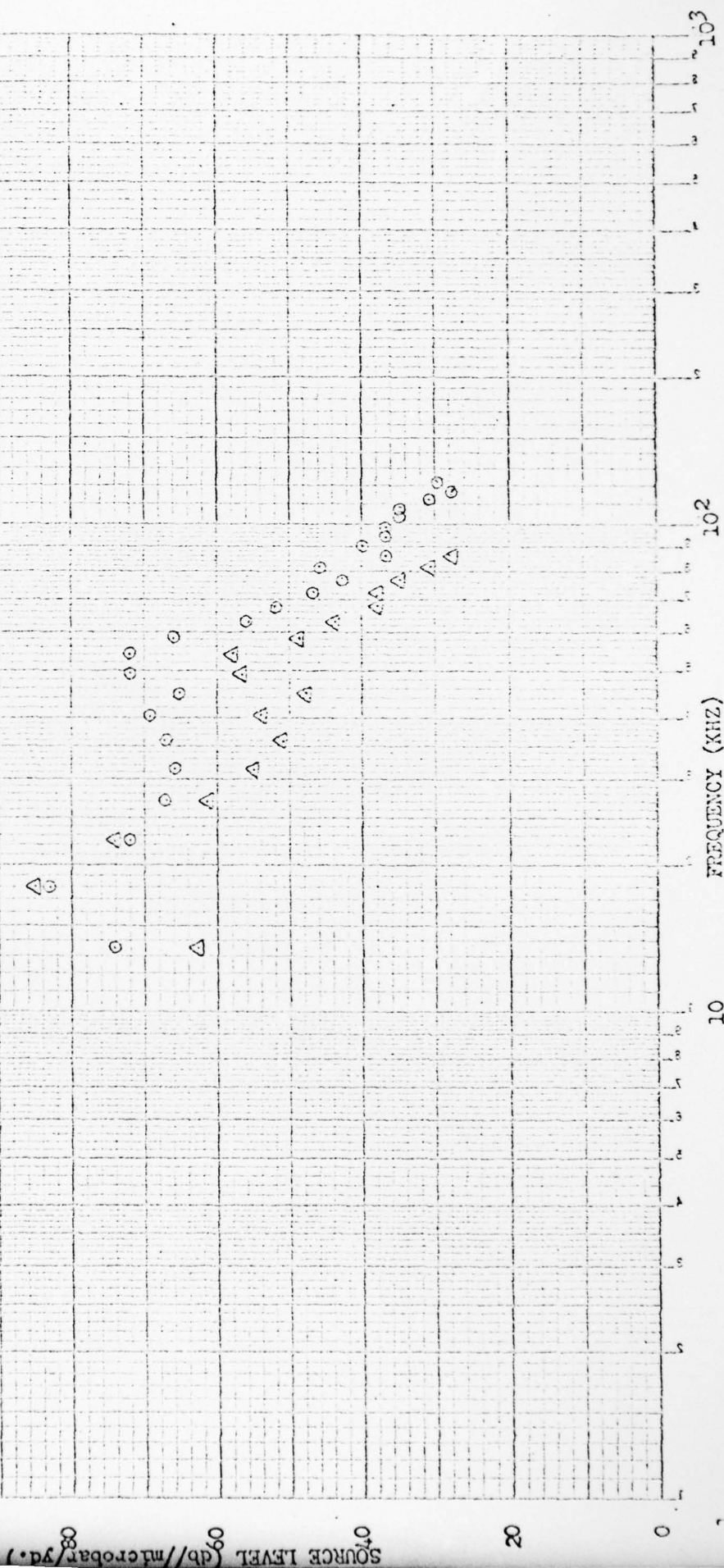
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MODE: OR2NI

TRANSMISSION FREQUENCY: 4.5 KHZ

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FREQUENCY (KHZ)

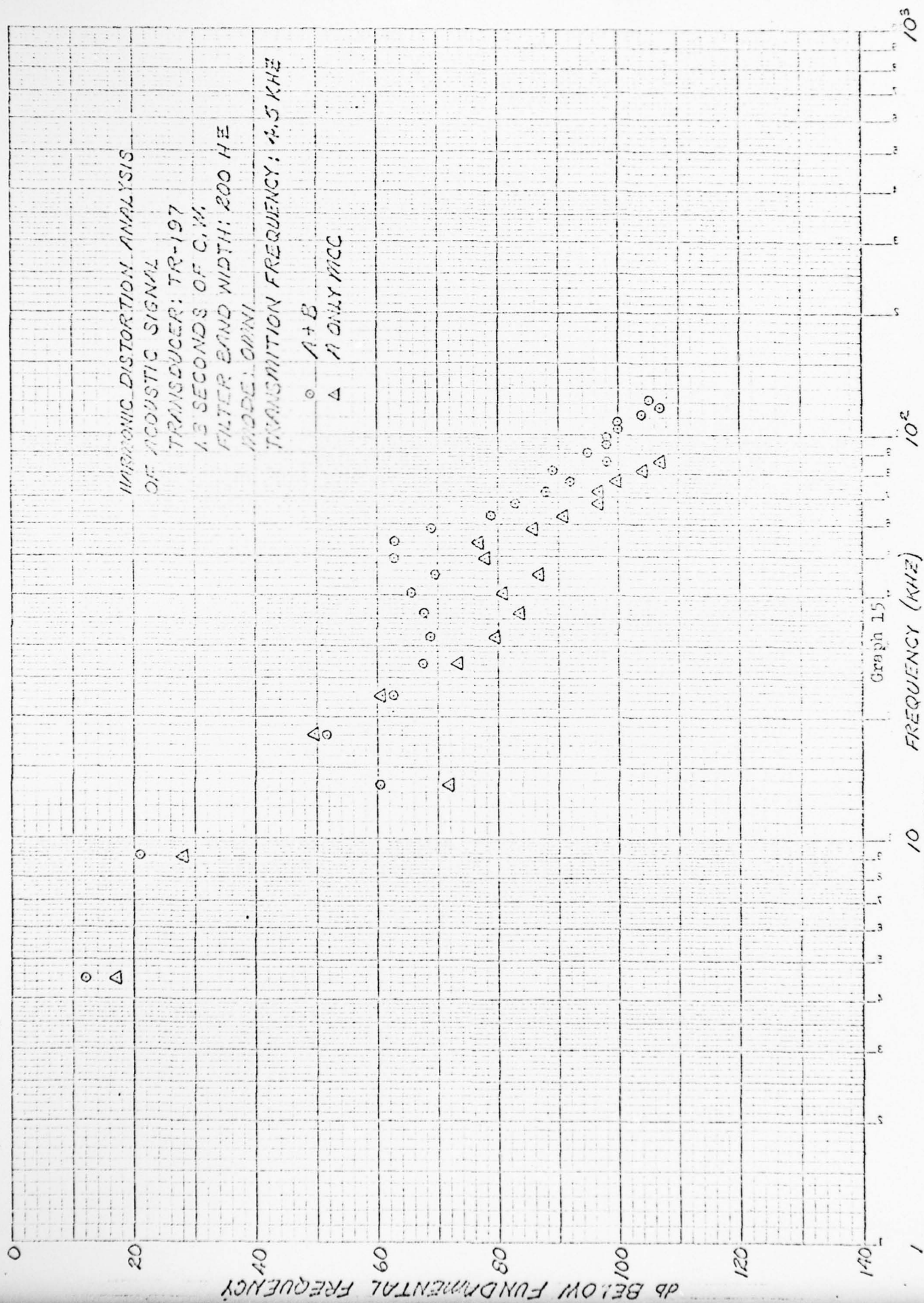
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О СЛУЖБЕ И ВОСПИТАНИИ
ВНЕШНЕГО РАБОТНИКА

ORIGINAL



HARMONIC DISTORTION ANALYSIS OF ACOUSTIC SIGNAL

TRANSDUCER: TR-197

1.3 SECONDS OF C.W.

7 1/2° BEAM WIDTH

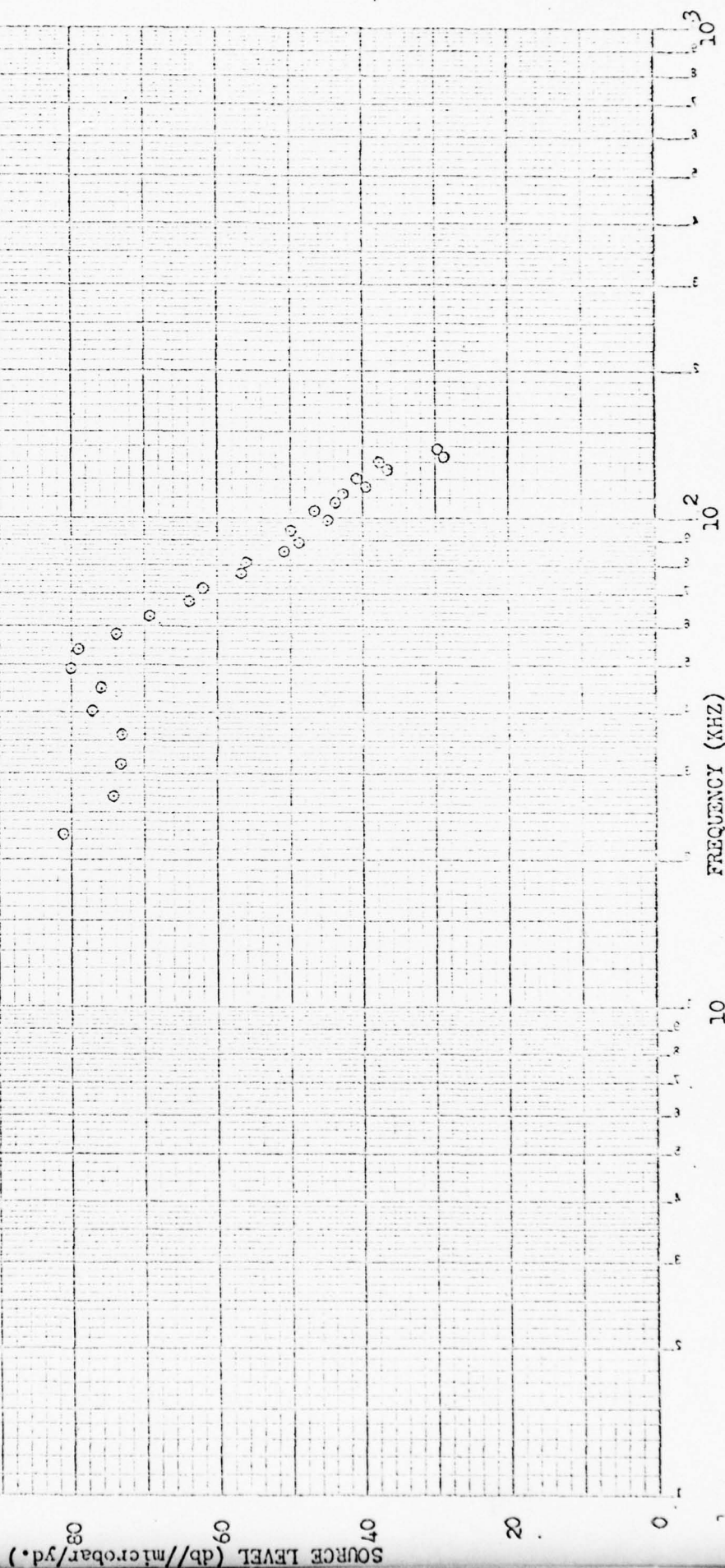
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MODE: RPT

TRANSMISSION FREQUENCY: 4.5 KHZ

⊙ $A+B$

Δ A ONLY MCC



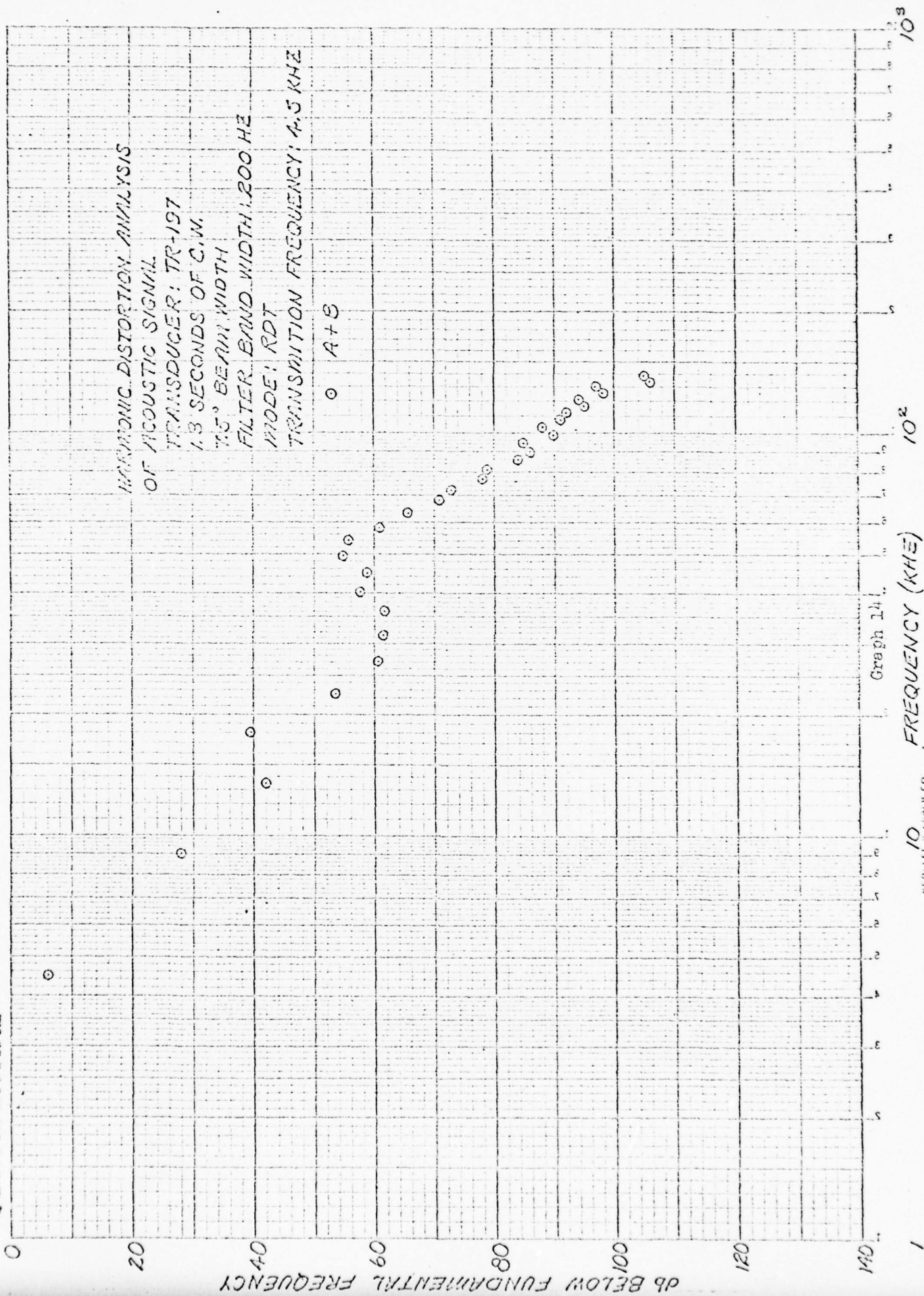
FREQUENCY (KHZ)

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HARMONIC DISTORTION ANALYSIS OF ACOUSTIC SIGNAL

TRANSDUCER: TR-197

1.3 SECONDS OF C.W.

7.5° BEAM WIDTH

FILTER BAND WIDTH: 200 HZ

MODE: S27

TRANSMISSION FREQUENCY: 4.5 KHZ

○ A+B

△ A ONLY MCC

SOURCE LEVEL (db/microbar/yard)

FREQUENCY (KHZ)

10

10

2

3

4

5

6

7

8

9

10

11

12

13

14

15

16

17

18

19

20

21

22

23

24

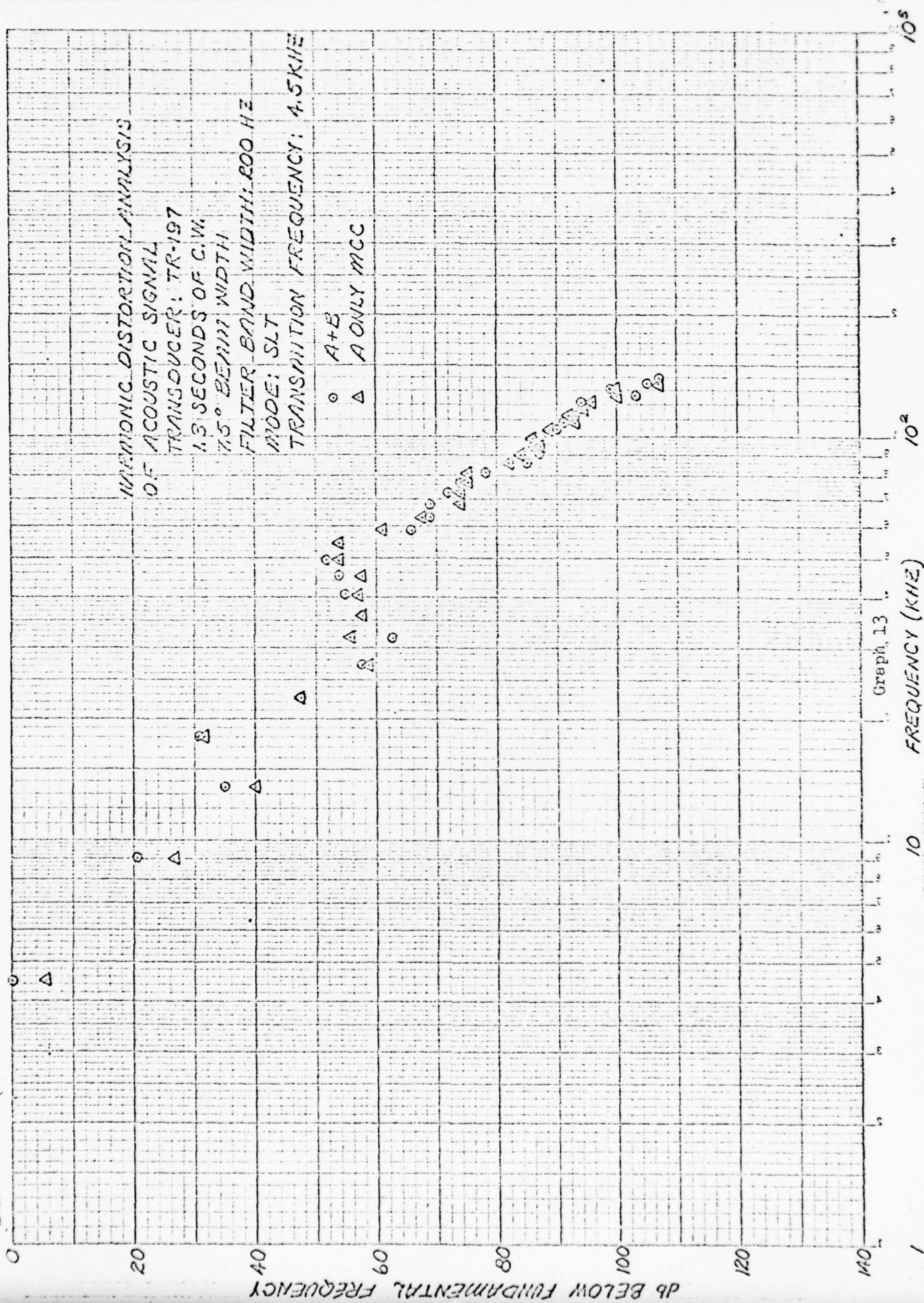
25

26

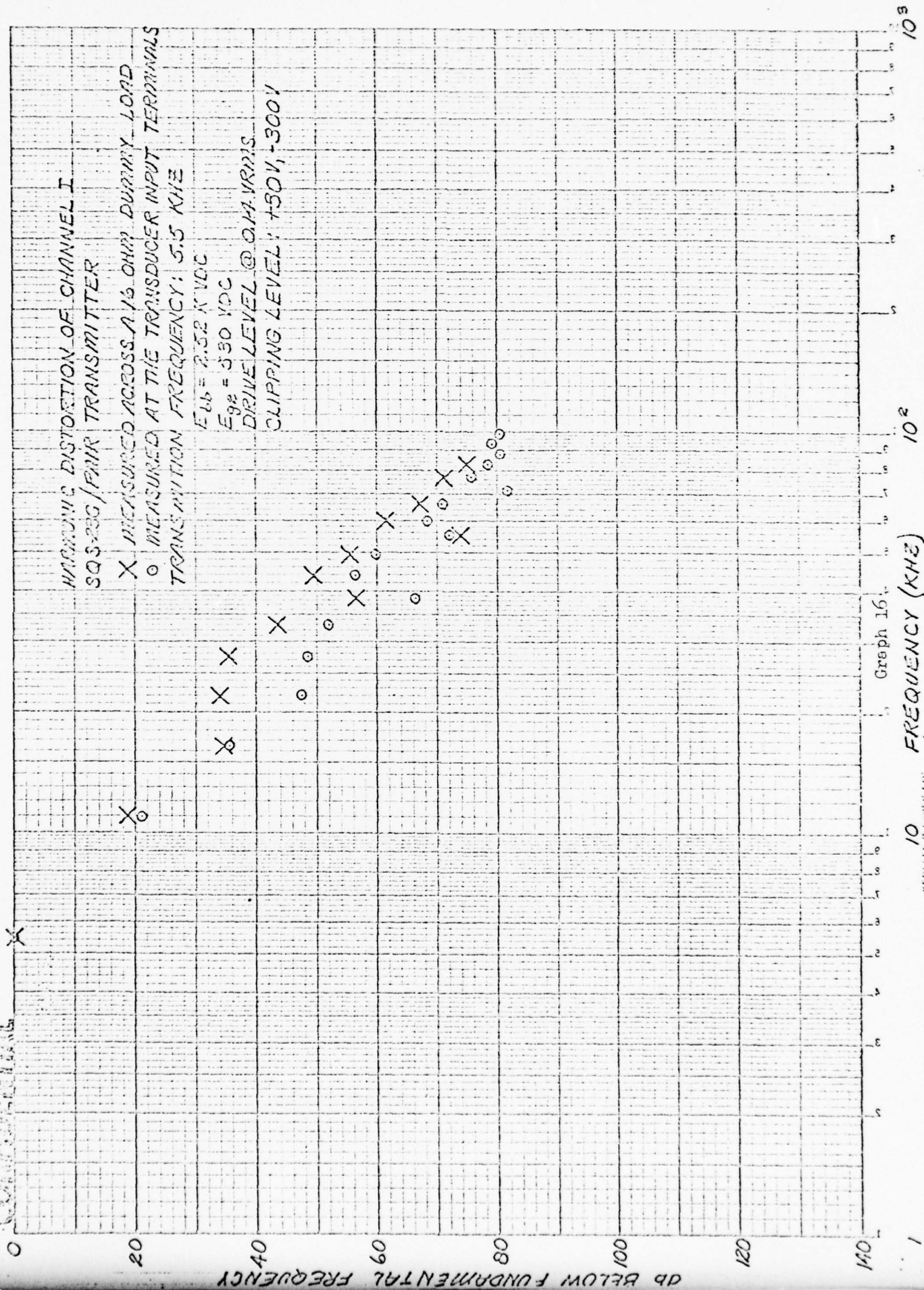
27

28

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0

X MEASURED ACROSS A 16 OHM DUMMY LOAD
O MEASURED AT THE TRANSDUCER INPUT TERMINAL
TRANSDUCER FREQUENCY: 4.5 KHZ

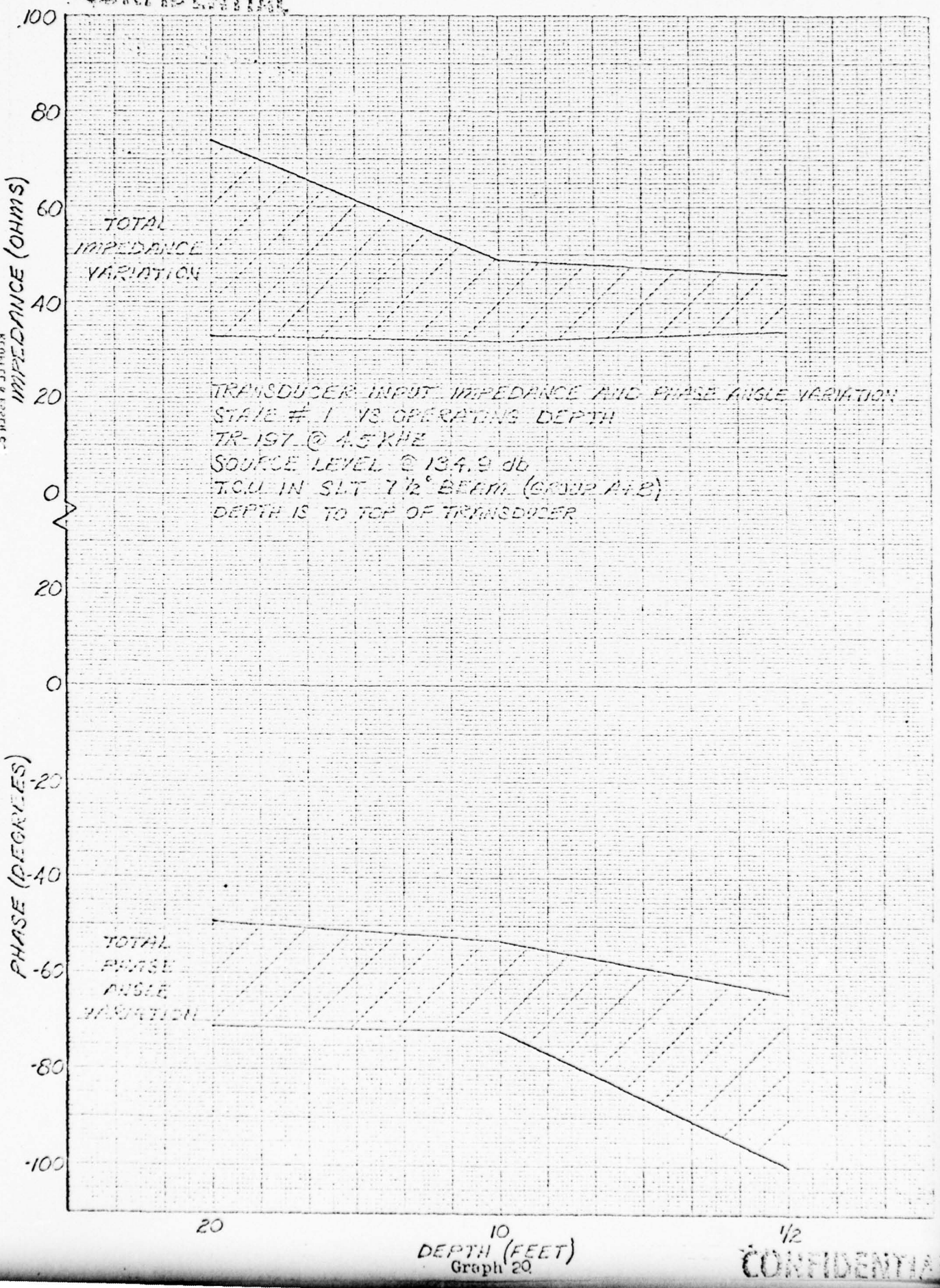
$E_{A6} = 3.52 \text{ K VDC}$
 $E_{A8} = 530 \text{ VDC}$
 DRIVE LEVEL @ 0.14 WPM'S
 CLIPPING LEVEL: +50V, 300V



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 RESEARCH OFFICE OF THE ARMY
 RESEARCH OFFICE OF THE ARMY
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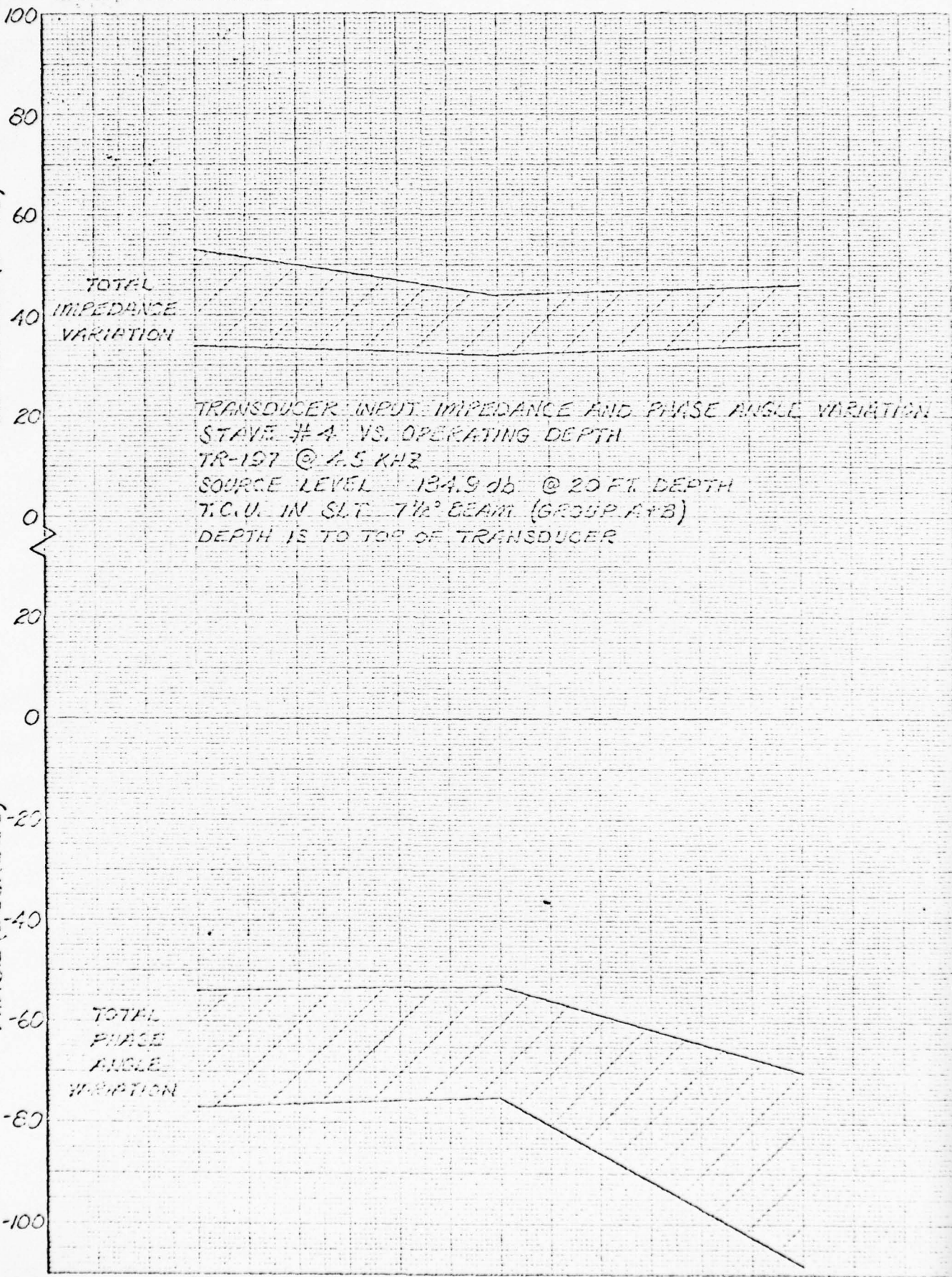
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10 X 25 CM. VIBRATION
10 X 10 TO THE CENTIMETER
40 12 IN
WATER

IMPEDANCE (OHMS)

PHASE (DEGREES)



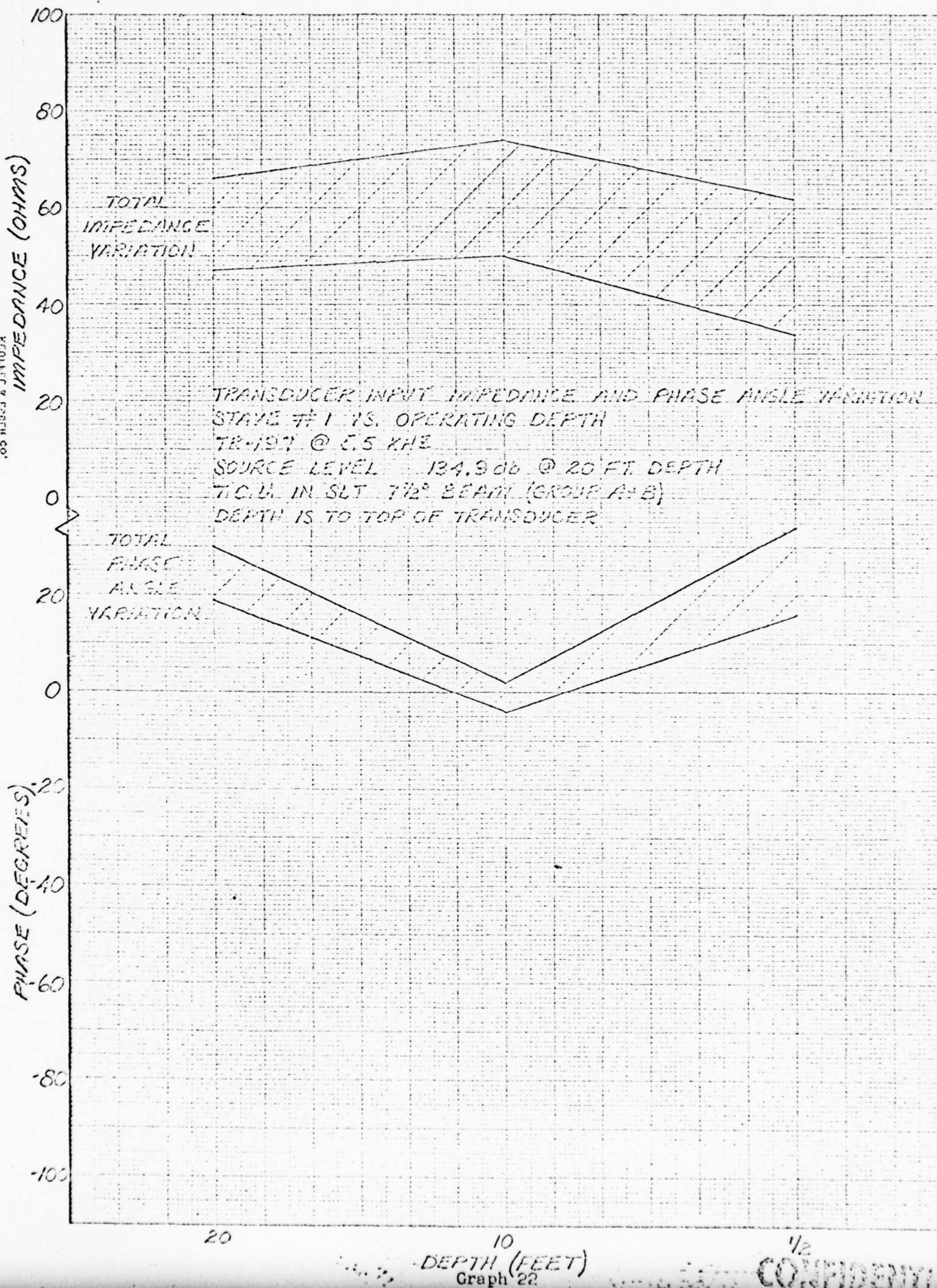
TRANSducer INPUT IMPEDANCE AND PHASE ANGLE VARIATION
STAVE #4 VS. OPERATING DEPTH
TR-197 @ 4.5 KHZ
SOURCE LEVEL 134.9 db @ 20 FT. DEPTH
T.C.U. IN SLT 7 1/2° BEAM (GROUP A+B)
DEPTH IS TO TOP OF TRANSDUCER

DEPTH (FEET)
Graph 21

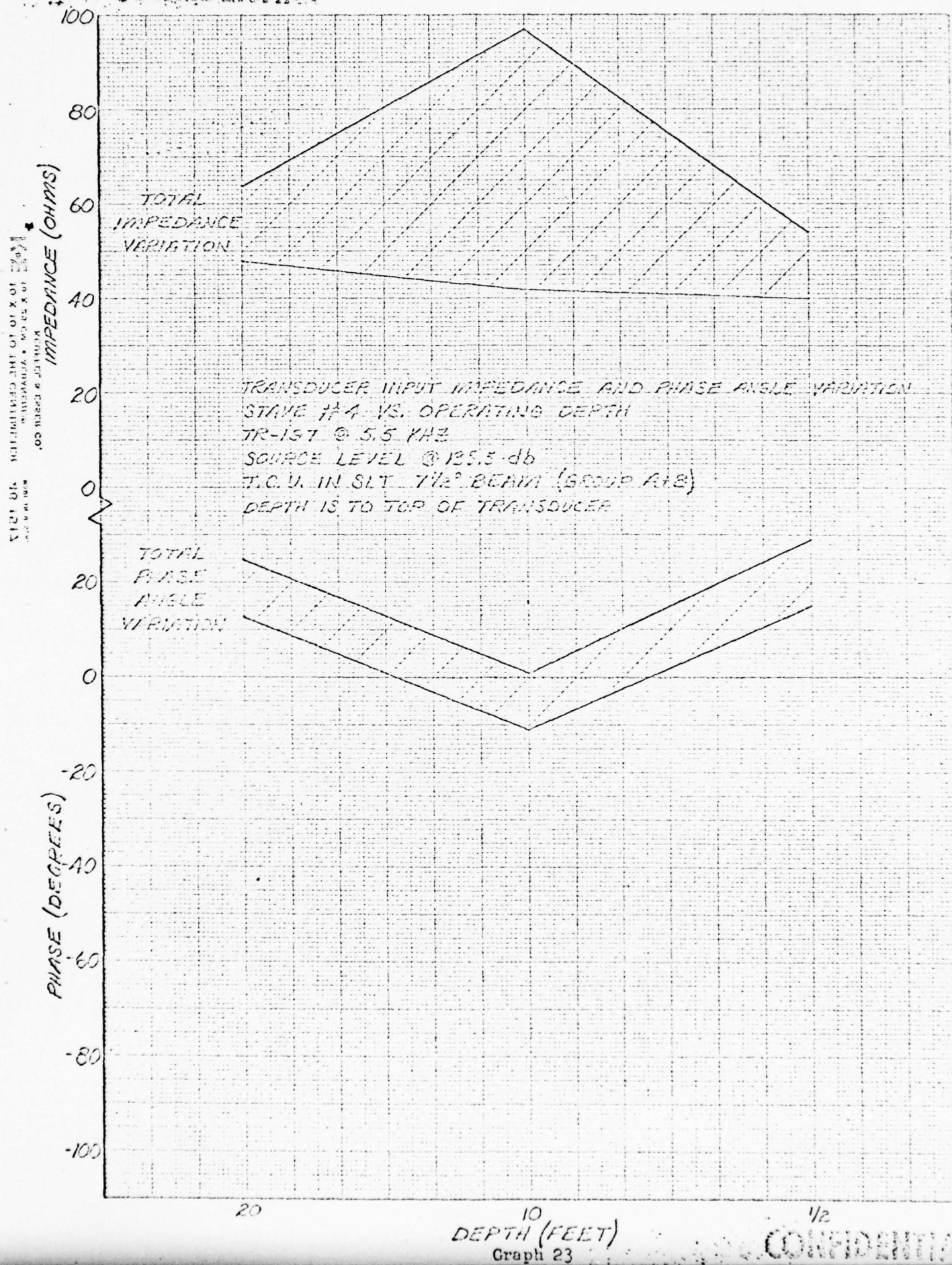
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JAN 19 1964
FROM THE
NAVY
JAN 19 1964
SUBJECT: TR-197 @ 0.5 KHZ



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RECEIVED & RECORDED
IN X 52 CM. & VERIFIED
IN X 10 TO THE CENTIMETER
NO 1013

DISSIPATION (WATTS)

1000
900
800
700
600
500
400
300
200
100
0

SOS-236/PAIR TRANSMITTER PLATE DISSIPATION VS.
TR-197 RAYTHEON TRANSDUCER OPERATING DEPTH
FREQUENCY: 4.5 KHZ STAVE 1 CHANNEL 1
SOURCE LEVEL 134.9 db @ 20 FT. DEPTH CHANNEL 25
DEPTH IS TO TOP OF TRANSDUCER
T.C.U. IN SLT 1/4" BEAM (GROUP A, B)
(PLATE DISSIPATION INCLUDES P.A. OUTPUT NETWORK)

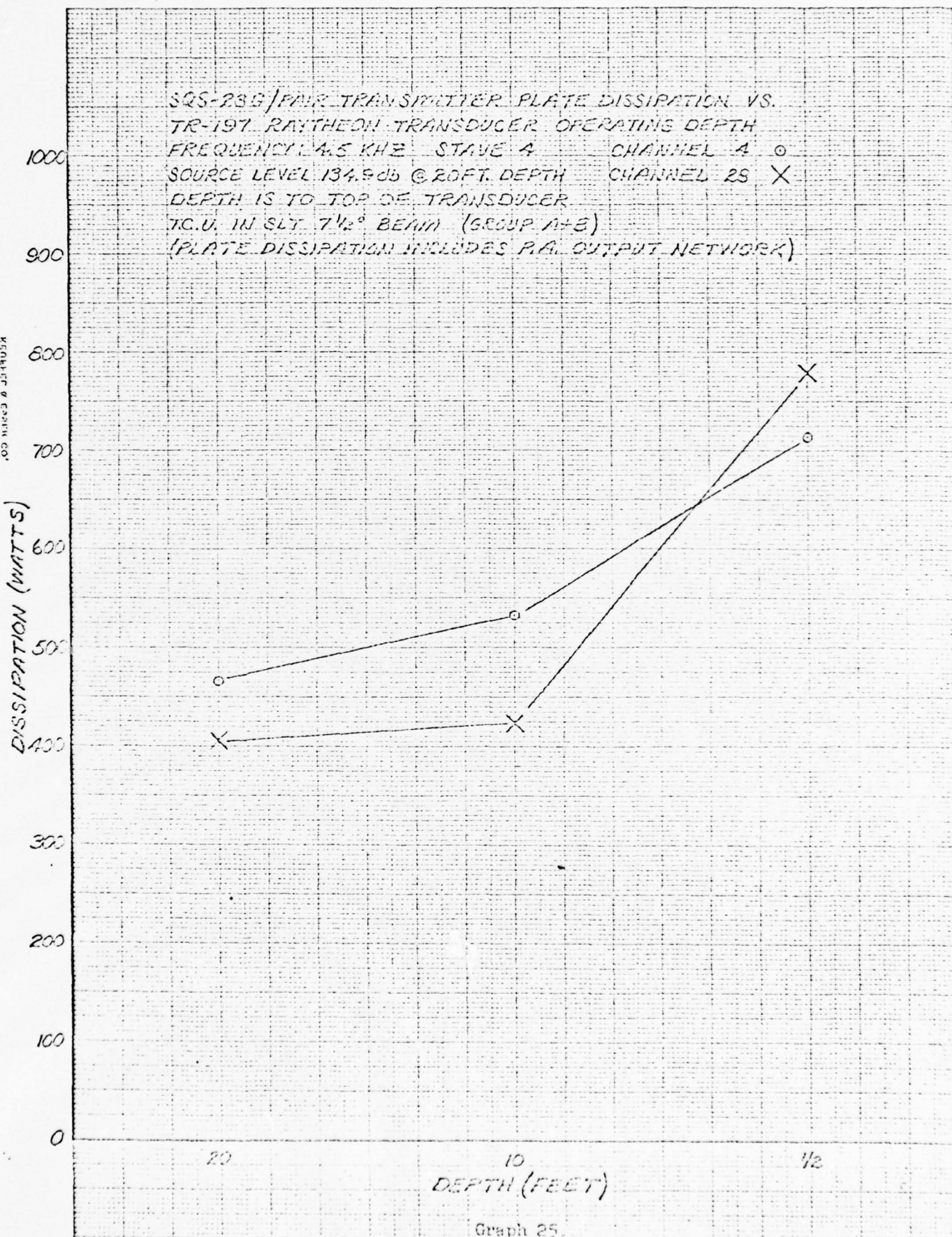


Graph 24

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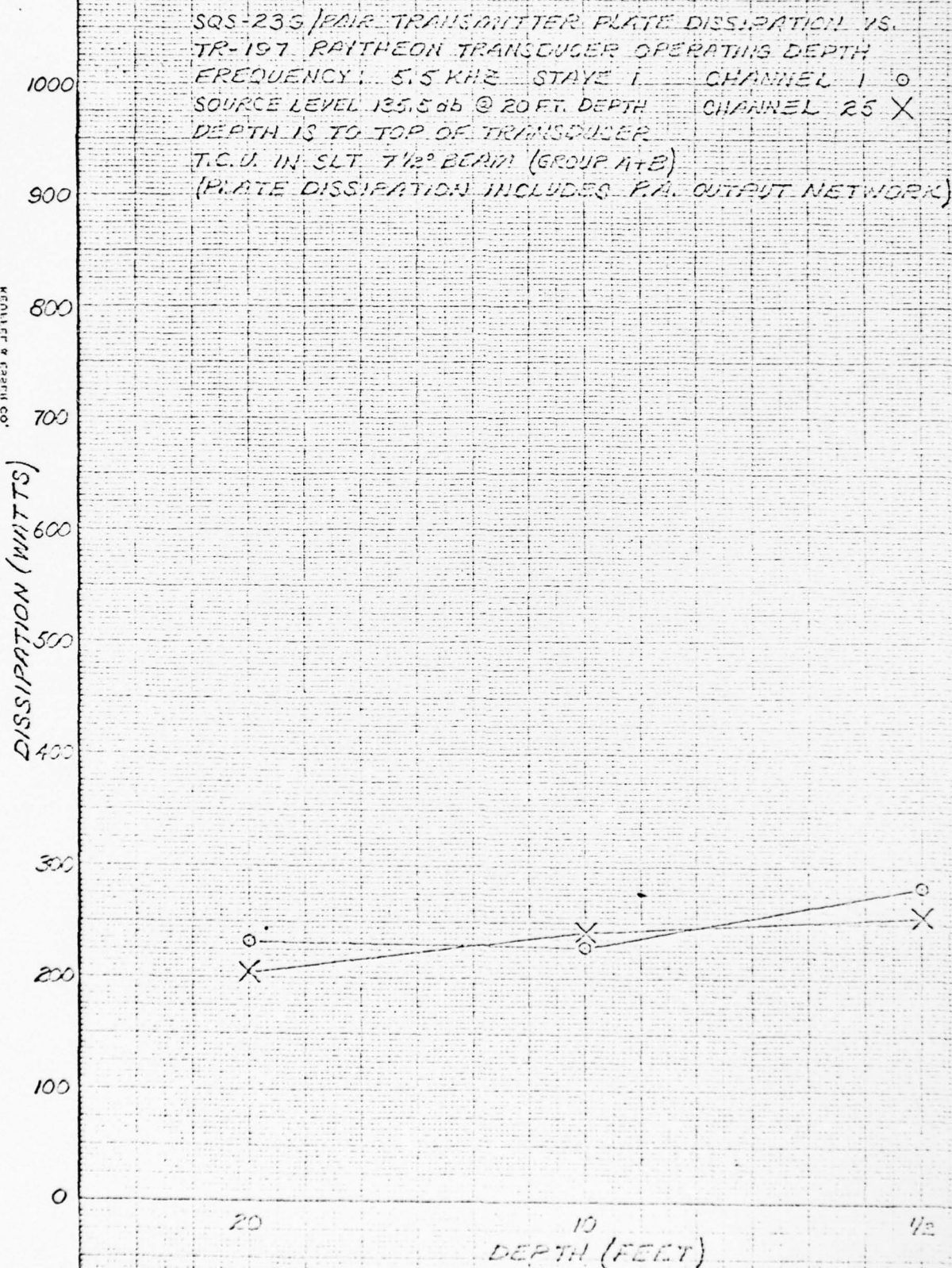
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Graph 26

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SQE-295/PAIR TRANSMITTER PLATE DISSIPATION VS.
 TR-197 RAYTHEON TRANSDUCER OPERATING DEPTH
 FREQUENCY: 5.5 KHZ STAVE 4 CHANNEL 4 O
 SOURCE LEVEL 135.5 db @ 20 FT. DEPTH CHANNEL 28 X
 DEPTH IS TO TOP OF TRANSDUCER
 T.C. 9. IN SLT 7 1/2° BEAM (GROUP A+B)
 (PLATE DISSIPATION INCLUDES PA OUTPUT NETWORK)

DISSIPATION (WATTS)

1000
900
800
700
600
500
400
300
200
100
0

20 10 1/2
DEPTH (FEET)

Graph 21

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SQS-236/PAIR TRANSMITTER PLATE CIRCUIT EFFICIENCY VS.
 TR-137 RAYTHEON TRANSDUCER OPERATING DEPTH
 FREQUENCY: 4.5 KHZ STAGE 1 CHANNEL 1 O
 SOURCE LEVEL 134.9 db @ 20 FT. DEPTH CHANNEL 25 X
 DEPTH IS TO TOP OF TRANSDUCER
 T.C.U. IN SLT 7 1/2° BEAM (GROUP 4-B)

EFFICIENCY (PERCENT)

100
90
80
70
60
50
40
30
20
10
0

20

10

DEPTH (FEET)

1/2

Graph 23

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EFFICIENCY (PERCENT)

100
90
80
70
60
50
40
30
20
10
0

SQS-23G/PAIR TRANSMITTER PLATE CIRCUIT EFFICIENCY VS.
TR-197 RAYTHEON TRANSMITTER OPERATING DEPTH
FREQUENCY: 4.5 KHZ STAVE 4 CHANNEL 4 O
SOURCE LEVEL 134.9 dB @ 20 FT. DEPTH CHANNEL 28 X
DEPTH IS TO TOP OF TRANSDUCER
T.C.U. IN SLT 7 1/2° BEAM (GROUP A+E)

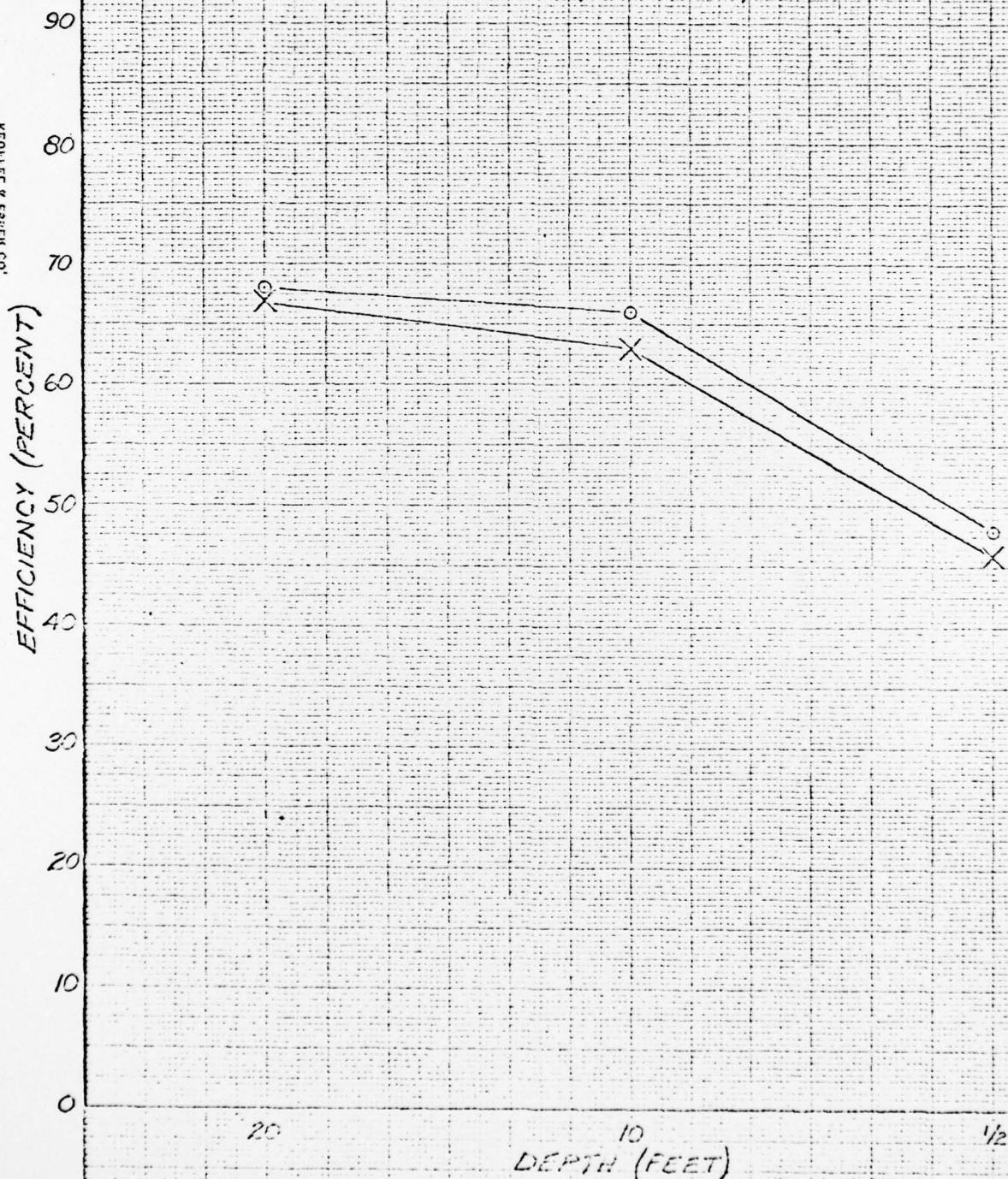
20 10
DEPTH (FEET)

Graph 29.

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SQS-235/PAIR TRANSMITTER PLATE CIRCUIT EFFICIENCY VS.
 TR-197 RATHCON TRANSDUCER OPERATING DEPTH
 FREQUENCY: 5.5 KHz STAVE 1 CHANNEL 1 O
 SOURCE LEVEL 135.5 db @ 20 FT. DEPTH CHANNEL 25 X
 DEPTH IS TO TOP OF TRANSDUCER
 T.C.U. IN SLT 7 1/2° BEAM (GROUP A+B)



Graph 30

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 KELLEY & EBER CO.
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 WILMINGTON, DE 19801

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SGS-235/PAIP TRANSMITTER PLATE CIRCUIT EFFICIENCY VS.
 TR-197 RAYTHEON TRANSDUCER OPERATING DEPTH
 FREQUENCY: 5.5 KHZ STAVE 4 CHANNEL 4.0
 SOURCE LEVEL 135.5 db @ 20 FT. DEPTH CHANNEL 23 X
 DEPTH IS TO TOP OF TRANSDUCER
 T.C.U. IN SLT 7 1/2° BEAM (GROUP A+E)

EFFICIENCY (PERCENT)

100
90
80
70
60
50
40
30
20
10
0

20

10

1/2

DEPTH (FEET)

Graph 31

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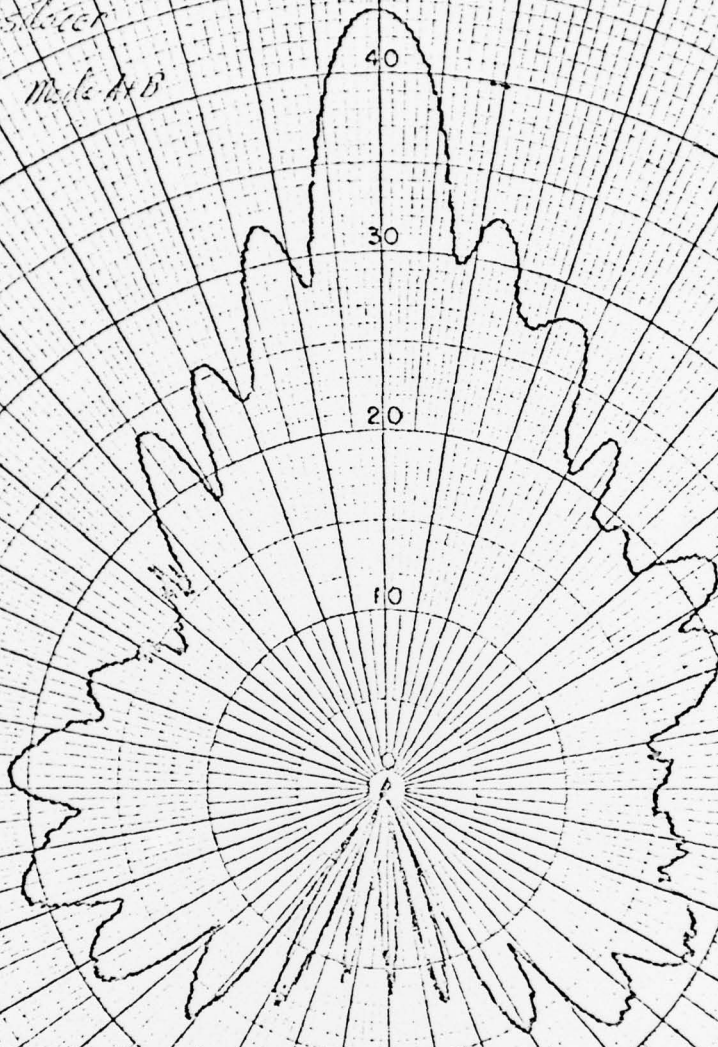
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TRANSDUCER CALIBRATION FACILITY
SAN DIEGO, CALIFORNIA 92152

78197 Transducer

541.45 KHz Mode A/B

72° B.W.



Frequency

Rotate

Depth

Test Distance

Temperature

°C

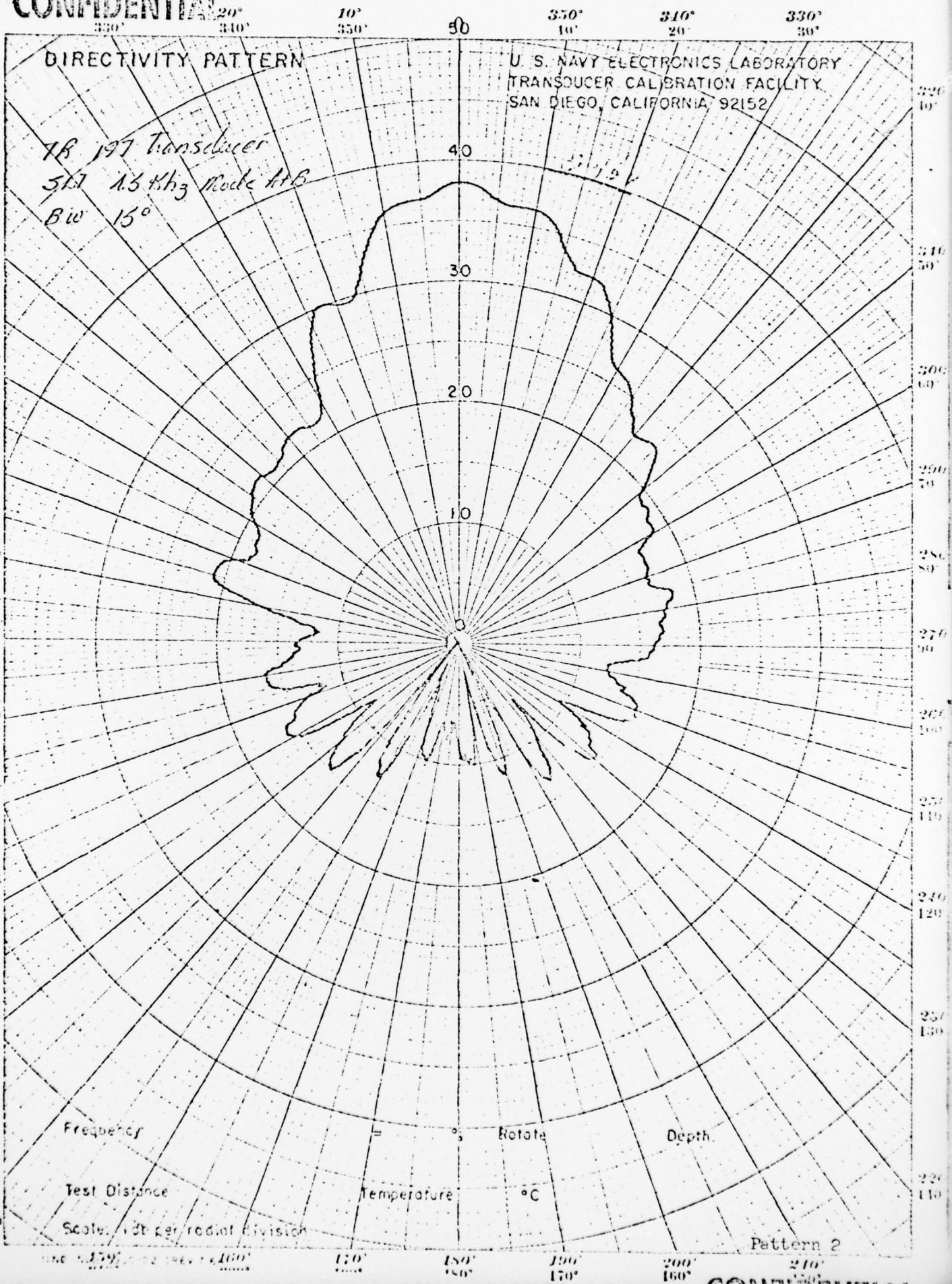
Scale: 1 db per radial division

Pattern 1

1180-9259/22 (REV. 1-6-60)

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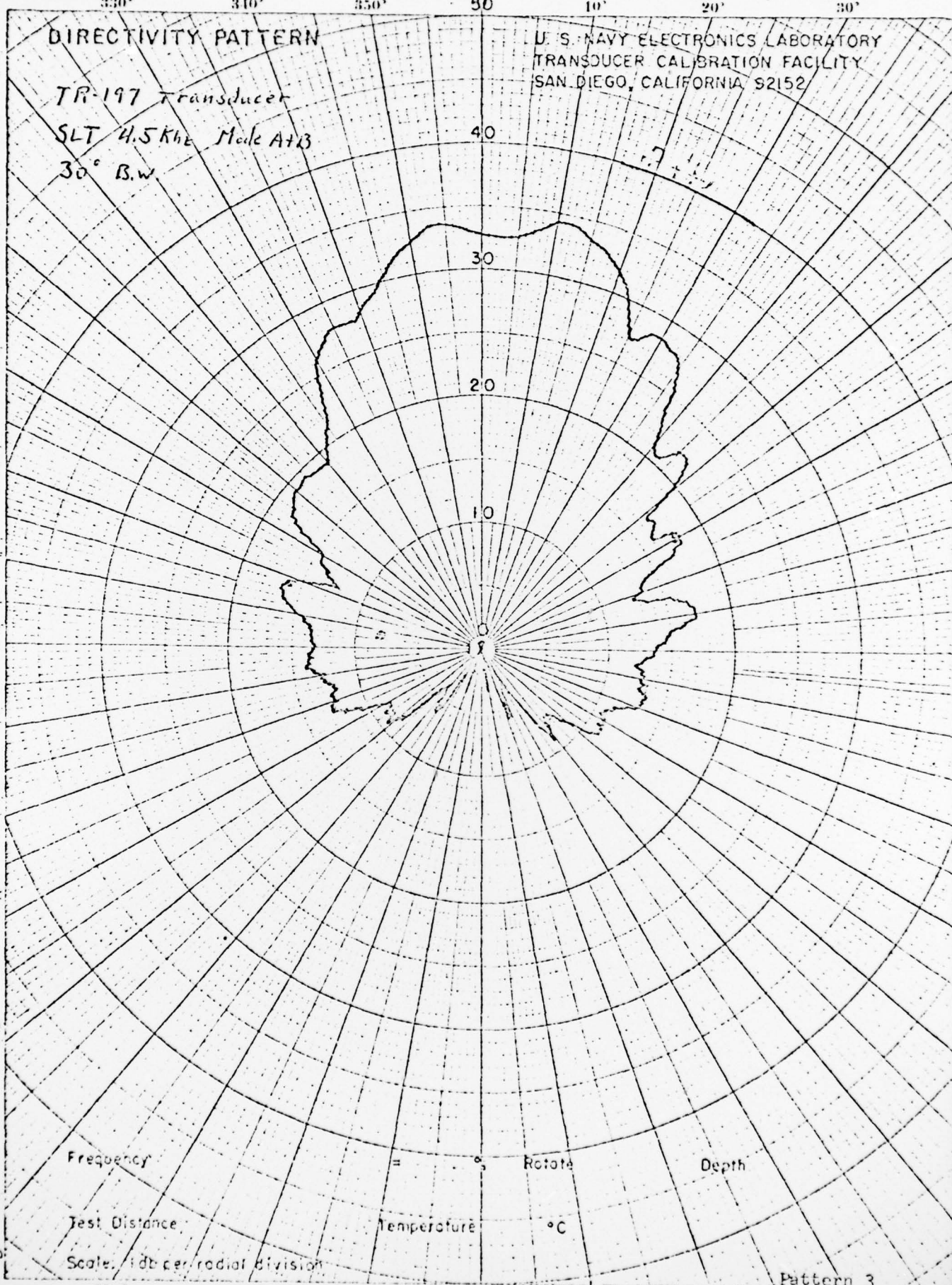
TR-197 Transducer

SLT 4.5 kHz Mode A+B

30° B.W.

40
320
50
310
60
300
70
290
80
280
90
270
100
260
110
250
120
240
130
230
140
220
150
210

320
10°
310
50°
300
60°
290
70°
280
80°
270
90°
260
100°
250
110°
240
120°
230
130°
220
140°
210°



Frequency

Rotate

Depth

Test Distance

Temperature

°C

Scale: 1 db per radial division

Pattern 3

160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0

170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0

180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0

190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0

200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0

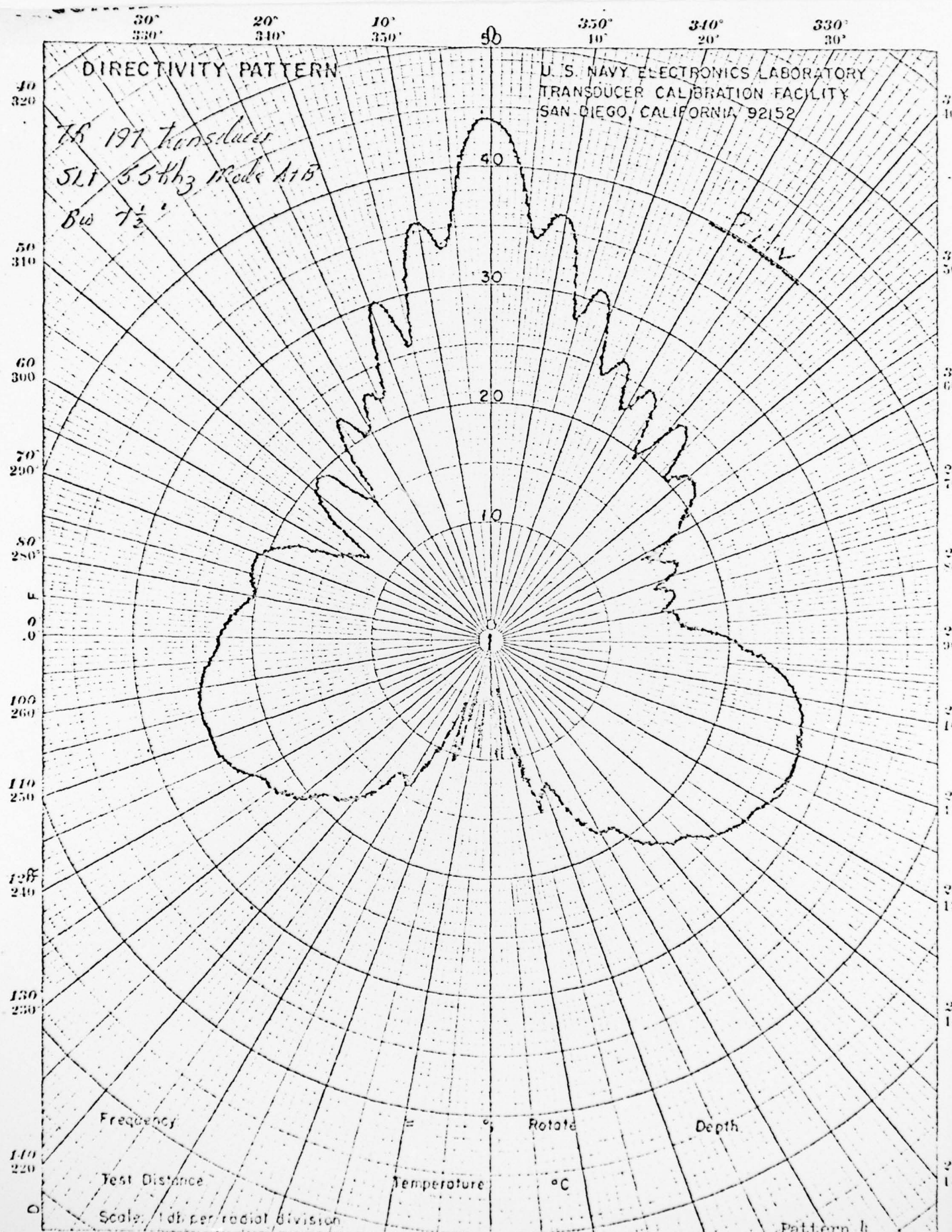
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0

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78 191 Transducer
521 35kHz Mode A+B
BW 7 1/2'



110° 100° 120° 130° 140° 150° 160° 170° 180° 190° 200° 210° 220° 230° 240° 250° 260° 270° 280° 290° 300° 310° 320° 330° 340° 350° 360°

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330° 20°
340°

10°
350°

50

350°
10°

340°
20°

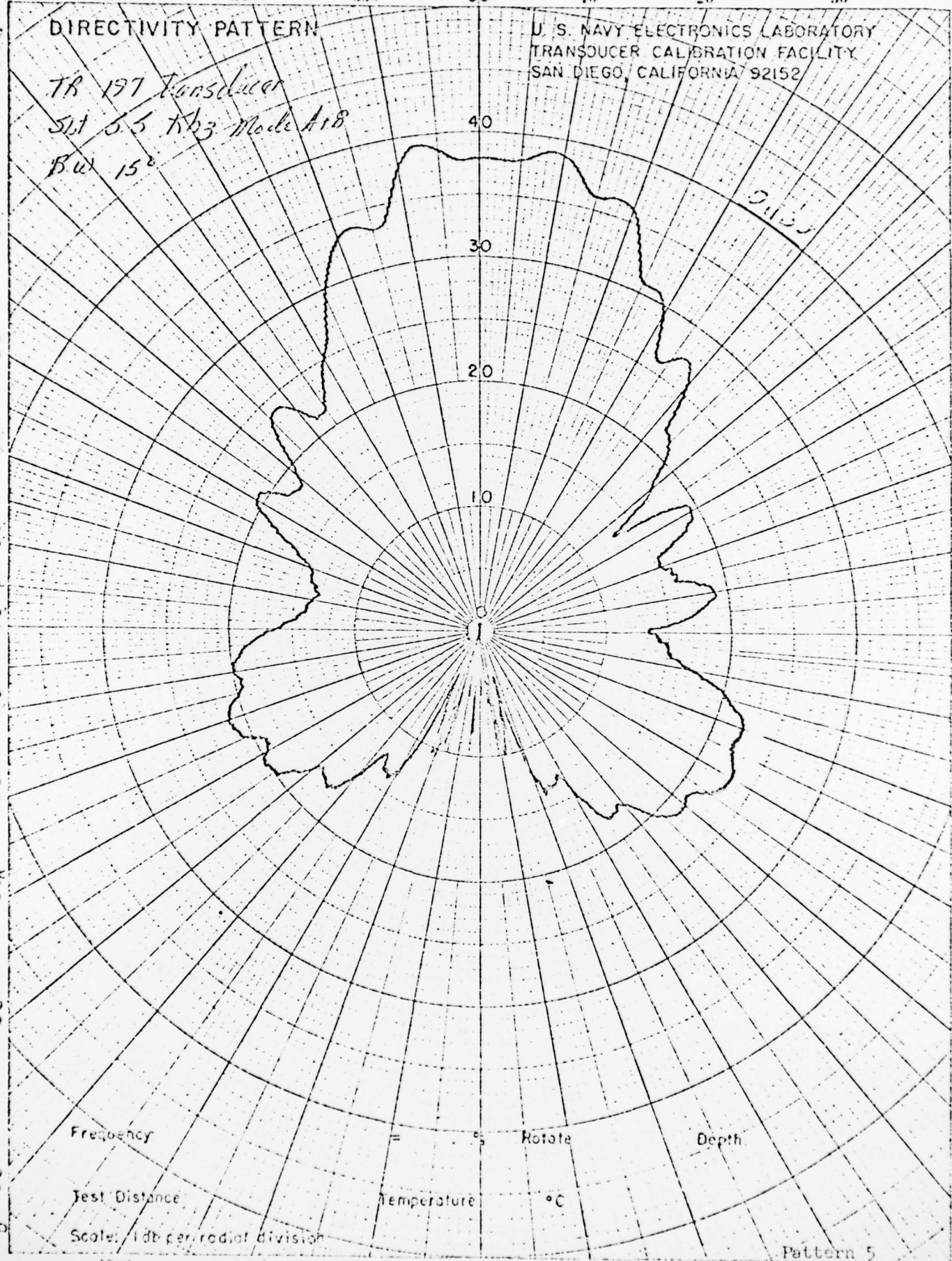
330°
30°

DIRECTIVITY PATTERN

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TR 197 Transducer
S/N 55 kHz Mode A18
BW 15°

21.5



Frequency

Rotate

Depth

Test Distance

Temperature °C

Scale: 1 db per radial division

Pattern 5

160° 170° 180° 190° 200° 210°

200° 210° 220° 230° 240°

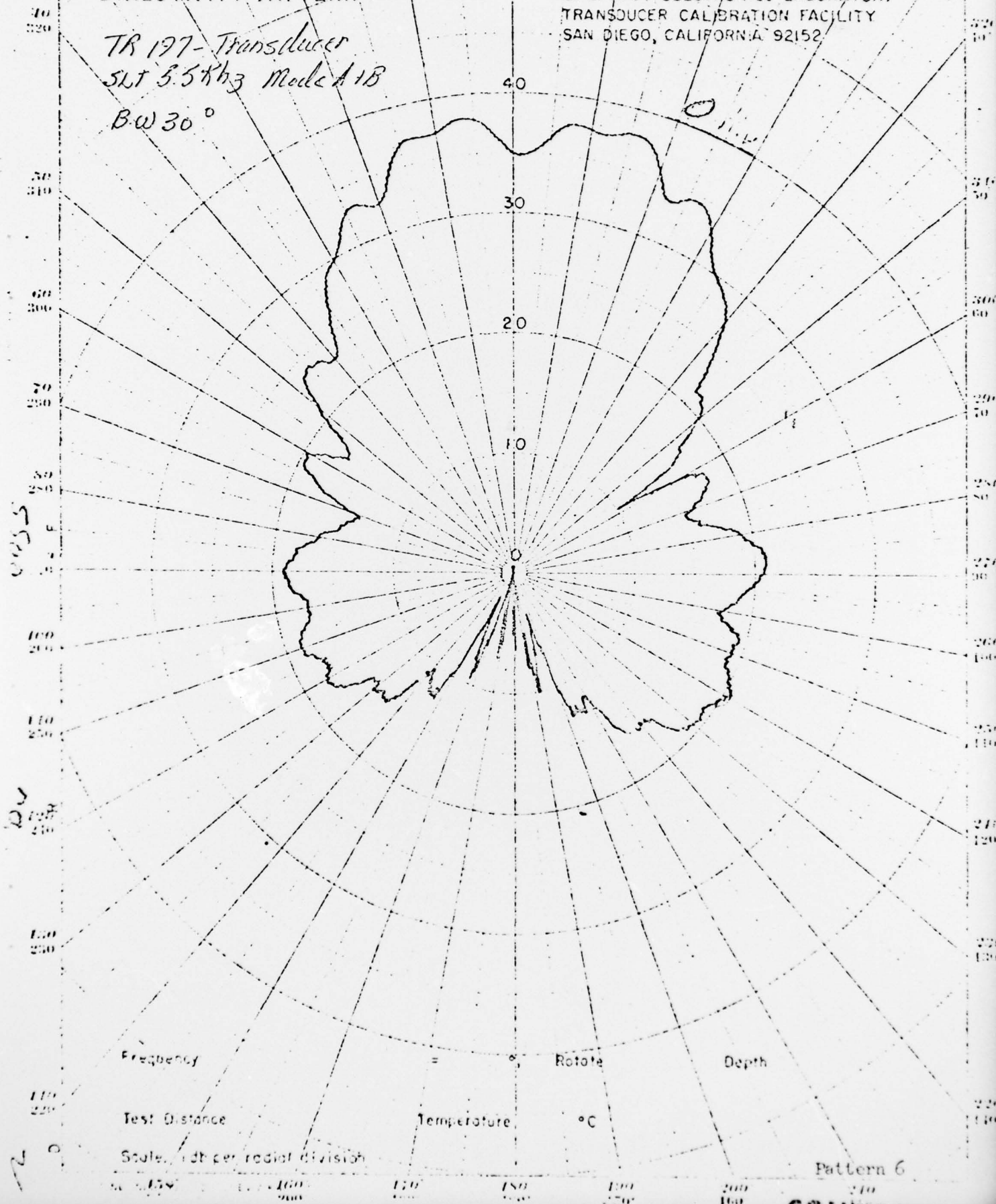
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U. S. NAVY ELECTRONICS LABORATORY
TRANSDUCER CALIBRATION FACILITY
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TR 197-Transducer
SLT 5.5 Khz Mode A+B
BW 30°

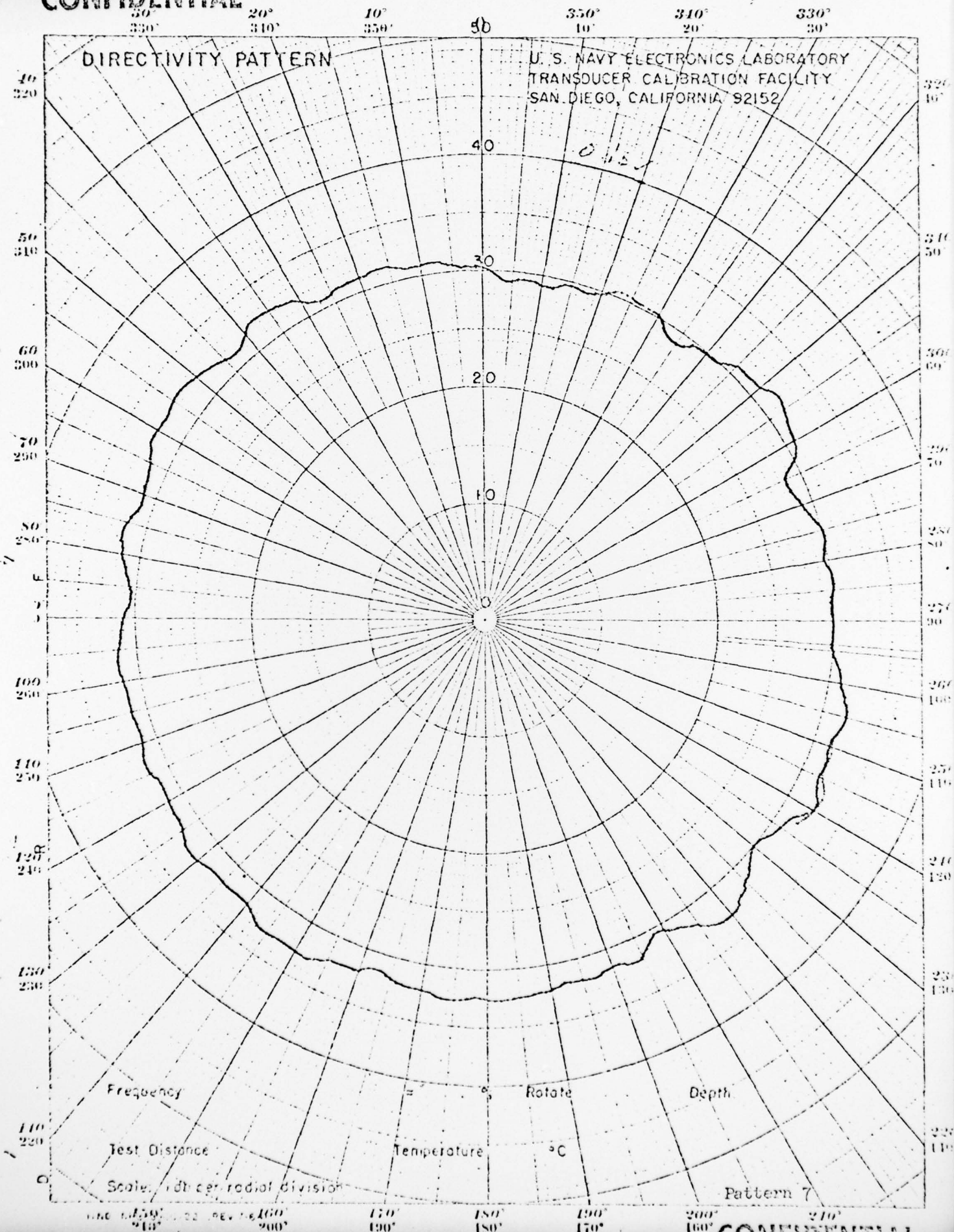


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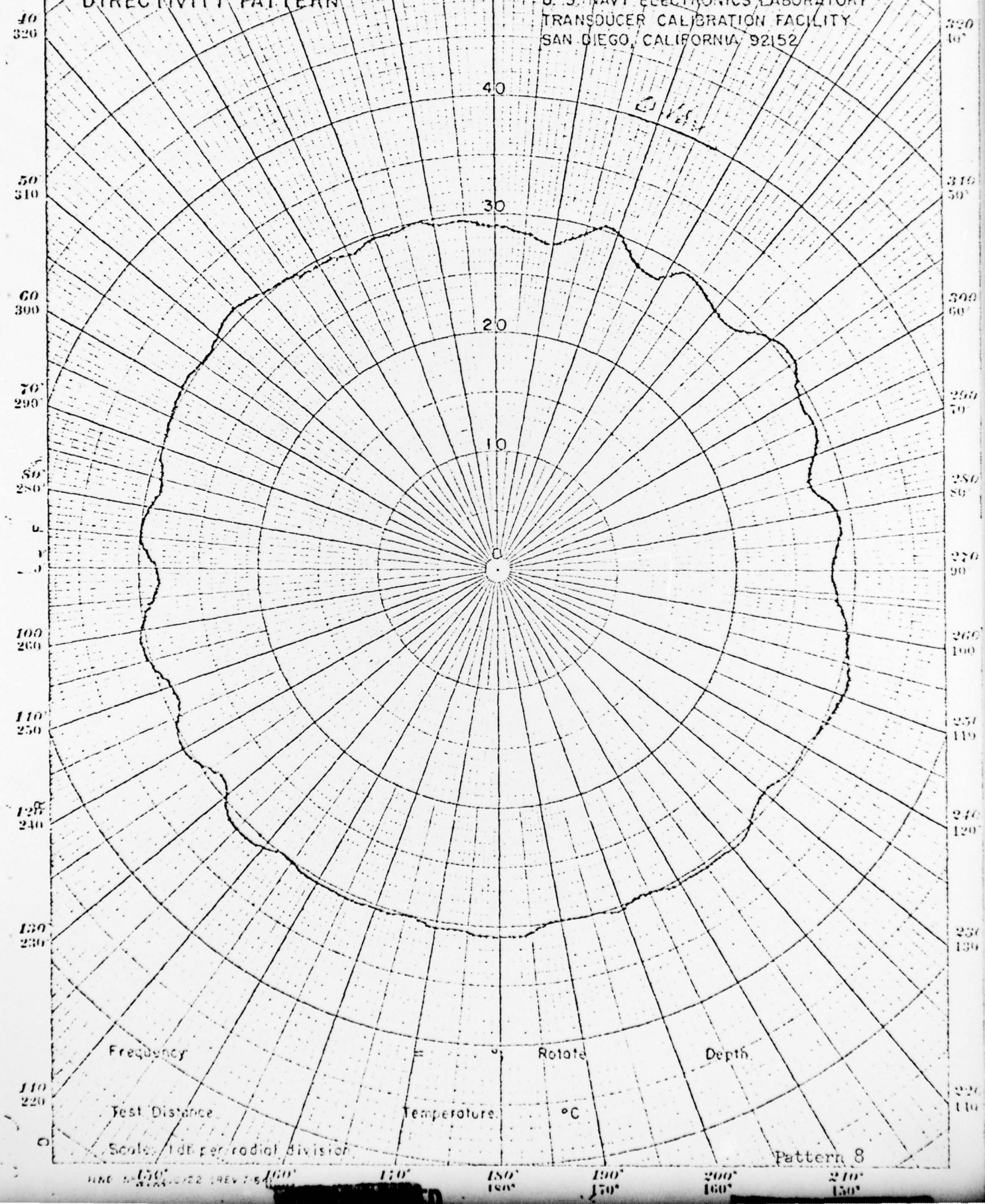
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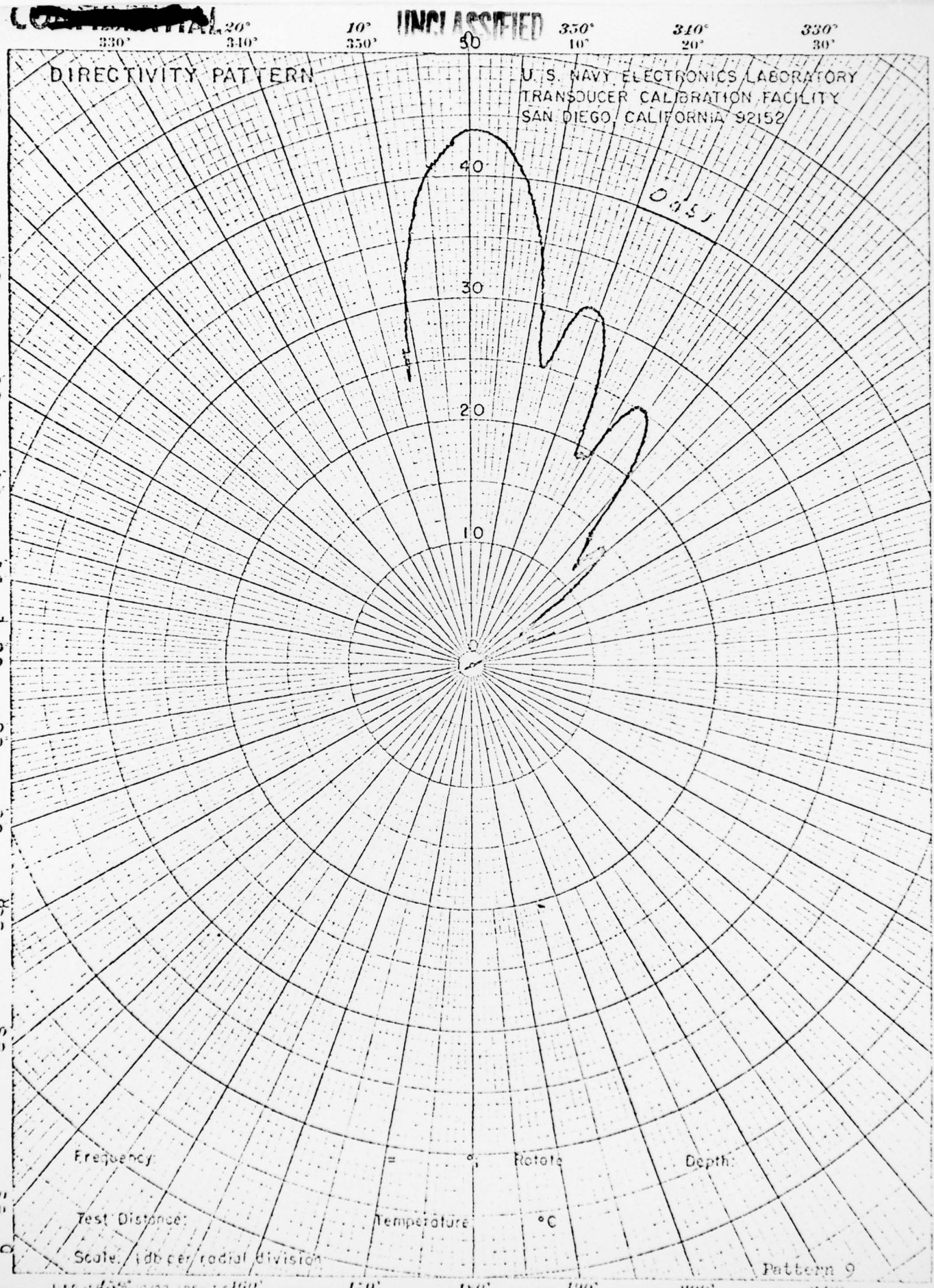
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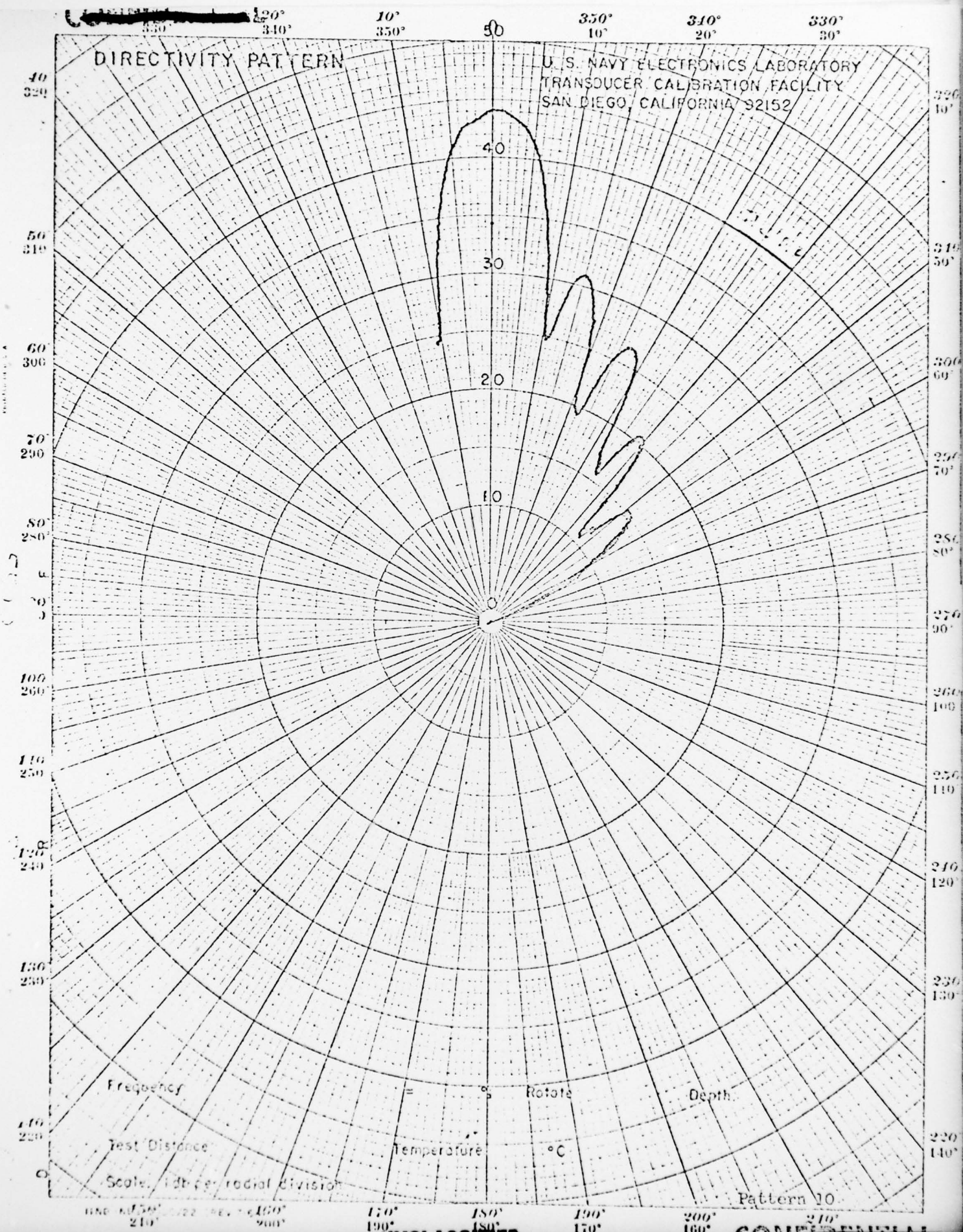


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Frequency

Rotate

Depth

Test Distance

Temperature °C

Scale: 1 db per radial division

Pattern 10

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